THE BRITISH WAR SHIP AGAMEMNON

Deck Plan

H.M.S. AGAMEMNON.

THIS ship, which has been undergoing considerable alterations at Devonport Dockyard, and has been tried in experimental trips in the Bay of Biscay, is now ordered to be commissioned for active service, and is going to re-enforce the British Naval Squadron on the China Station. The Agamemnon is a double-screw armor-plated turret ship, constructed of iron, carrying four heavy guns in her two turrets; her tonnage capacity is 8,510 tons, and her engines are of 6,360 horse power. She is commanded by Captain Samuel Long, an officer who served in the old Agamemnon, wooden line-of-battle ship, in the Black Sea, and at the bombardment of the forts of Sebastopol, under Admiral Sir Edmund Lyons. The new Agamemnon, of which we give an illustration, is a very different sort of vessel; and, though her fighting power must be considerable, some doubts have been expressed of her fitness to encounter rough weather at sea. The oblique position of the two gun turrets on deck, as indicated in the plan which accompanies our illustration, does not seem favorable to security of balance, and has been disapproved by professional critics.—*Illustrated London News.*

THE NEW ARTESIAN WELL AT FORT SCOTT, KANSAS.

SOME months since a company was formed at Fort Scott to sink a well for the purpose of obtaining gas. The well was bored to a depth of 621 feet, and although gas was not found, an abundant supply of water was struck.

The well was first bored on the first bench on the south side of the Marmaton River, at the foot of the bluff, and 550 feet from the channel. Above the mouth of the well is a bluff consisting of limestone, hydraulic cement rock, coal, fire-clay, and bituminous shale. The diameter of the well is eight inches down to 335 feet, to which point the well was tubed with iron pipe. Below that point the well was bored dry forty-five feet, at which point a fourteen-inch crevice was struck, and salt water rose to within ten feet of the surface. The boring was continued till a depth of 621 feet was reached, and on removing the drill a clear steady flow of over 10,000 gallons of water per day was obtained. There seems to be a continuous flow, with but little gaseous agitation. The pressure will carry the water to a height of five feet above the mouth of the well. The water remains at this height till the altitude is diminished.

The drill record, which follows, as well as other interesting facts, were furnished by E. F. Nave, Esq., of Fort Scott:

Wash-dirt	25	feet.
Clay	5	"
Soapstone	15	"
Slate	3	"
Coal	2	inches.
Soapstone	15	feet.
Slate	2	"
Coal	2	inches.
Soapstone	17	feet.
Blue Limestone	3	"
Soapstone	95	"
Soft Sandstone	5	"
Soapstone	70	"
Brown Sandstone	25	"
Gray Sandstone	7	"
White Sandstone	25	"
Slate	12	"
Fire Clay	4	"
Soapstone and Clay	10	"
Slate and Iron-pyrites	5	"
Flint	23	"
Flint and Limestone	14	"
Crevice	14	inches.
Limestone	4	feet.
Limestone and Flint	75	"
Very Hard Flint	5	"
Mixed Flint and Limestone	156	"
Total	621	feet.

An analysis of the water shows it to have the following composition, the weights being estimated in grains per U. S. gallon of 231 cubic inches:

Hydrosulphide of Sodium	0·188	grains.
Chloride of Sodium	79·471	"
Biborate of Soda	2·204	"
Chloride of Potassium	Trace.	
Chloride of Lithium	"	
Chloride of Magnesium	7·987	"
Chloride of Calcium	0·787	"
Sulphate of Lime	0·829	"
Bicarbonate of Lime	14·238	"
Bicarbonate of Magnesia	0·305	"
Bicarbonate of Iron	1·006	"
Sulphate of Soda	Trace.	
Silica	0·951	"
Organic Matter	1·166	"
Total Solids	109·132	"
Sulphureted Hydrogen Gas	Trace.	
Carbonic Acid Gas	Trace.	
Temperature of Water	67½°	

This may be classed as one of the sulpho-saline waters, containing borax and lithium as rare ingredients. Comparing this water with that of other springs and wells, we find it to be similar to the celebrated "Blue Lick" spring of Kentucky, except that the Fort Scott water is more dilute, and the former does not contain borax. From a consideration of the strata through which the well passes, and the composition of this water, it seems probable that it is a mixture of waters from different depths.

University of Kansas, Lawrence, December, 1884.

THE Peruvian Government ask for proposals for the purchase of 400,000 tons guano, to be loaded at Lobos de Afuera and the southern deposits. Four months from December 1 are allowed for the presentation of tenders, and contractors will not be required to ship for two months after the adjudication of the contract. The first month's shipment must not be less than 5,000 tons, and every succeeding month not less than 15,000 tons.

HYDRAULIC ELEVATOR ON THE NEUFFOSSE CANAL.

THE Société Anonyme des Anciens Etablissements Cail, which has in charge the construction of an elevator on the Neuffosse canal, has recently made some experiments at its Grenelle works with a hydraulic press of a new system which it has patented. Having been present at these experiments, we think it will prove of interest, in connection therewith, to recall the principal features of the elevator under consideration.

I. The Neuffosse canal connects the ports of Calais, Gravelines, and Dunkirk with the channeled beds of the Lys and Escaut at the north, and with the St. Quentin canal at the south, thus putting our ports of the Strait of Dover in communication with Lille and Belgium on the one hand, and with the basin of the Seine and Paris on the other.
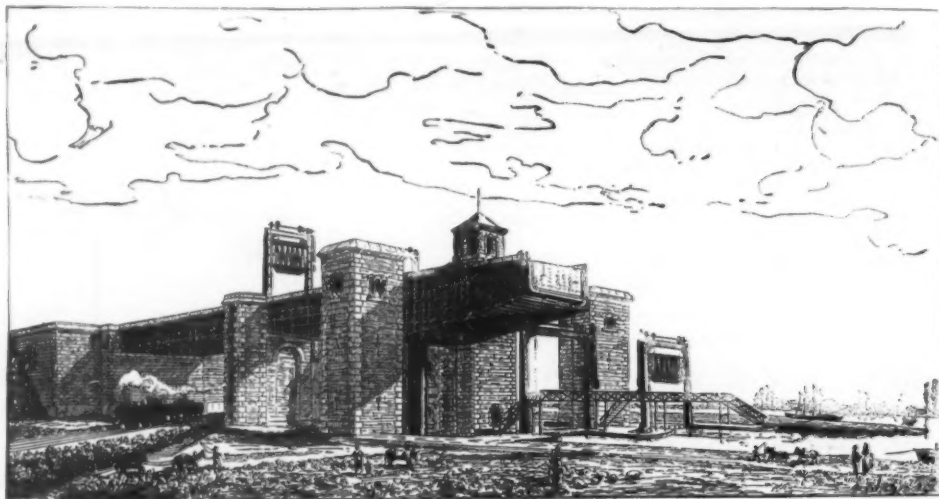

FIG. 1.—HYDRAULIC ELEVATOR AT FONTINETTES, ON THE NEUFFOSSE CANAL.

This canal, as regards traffic, is one of the most important of Northern France. Unfortunately, at one point of its course, at two and a half miles up the Saint Omer, it is interrupted at a place called "Fontinettes" by a series of five superposed locks. The encumberment caused by these has for several years been such that it has been necessary to devote half of each week to the passage of the boats going up, and the other half to the passage of those going down. This regulation permits of reducing the time taken for the passage of a boat to one hour and forty minutes. Such a delay, however, is still much too long on account of the traffic, and so, because of the complaints of the Chambers of Commerce, and of the Councils General of the North and Strait of Dover, the Minister of Public Works instituted a study of the means necessary to remedy such a state of things. In answer to a call made in 1880, several projects were presented, and, after an examination of the different propositions of the competitors, the Council General of Bridges and Roadways decided to adopt a hydraulic elevator of the Clark type, which should permit of reducing the time taken to pass a boat, by five minutes only.

II. This apparatus consists essentially of two lock chambers that may be considered as portions of a canal capable of holding the largest boats. Each of them is in equilibrium at the extremity of a hydraulic press, and the two presses are connected with each other by a pipe provided with a sliding valve.

The two chambers and two presses are identical, and the size of the former was determined from the dimensions of the largest boats that they would have to hold. On the Neuffosse canal the boats to be transferred are of about 300 tons burden, and their length is 126 ft., breadth 16·5 ft., and draught 6 ft. The chambers are consequently 130 feet in length, 18 in width, and 6·5 in depth. The stroke of the press pistons is fixed by the difference in level between the upper and lower canal, this being 43 feet. The diameter of the pistons is 6·5 feet.

In order to make the working of this apparatus properly understood, we must remark that for a given depth of water in the chamber, the weight of the latter is the same whether it contains boats or not, and that when the two chambers are on a level, and the communication between the presses is open, the system will be in equilibrium if the two chambers are of the same weight. If, on the contrary, the two chambers are of different weight, the heavier will descend, and force the lighter to rise. Let us suppose the piston of one of the presses to be at the upper end of its travel, and the piston of the other at the lower end of its travel, and the valve between the two presses to be closed. In this position the chamber placed at the extremity of the piston that has risen from its press will be on a level with the upper canal, while the other will be on a level with the lower one. Let us introduce a boat into each of the chambers, which at this moment are forming a
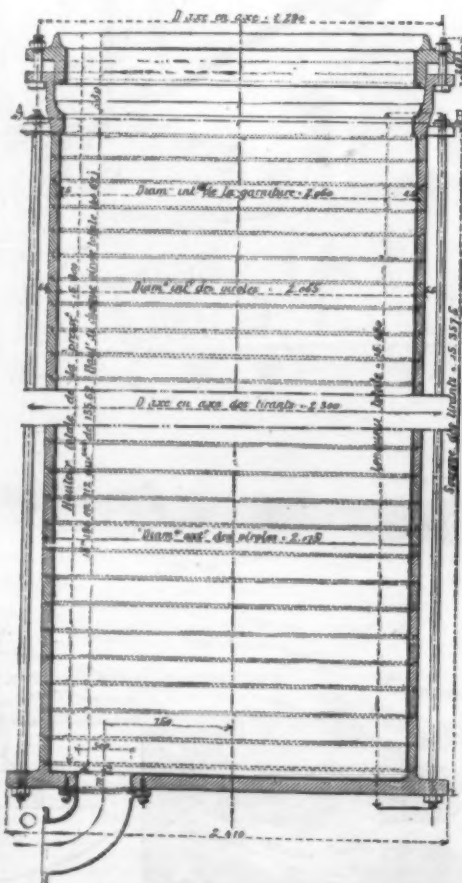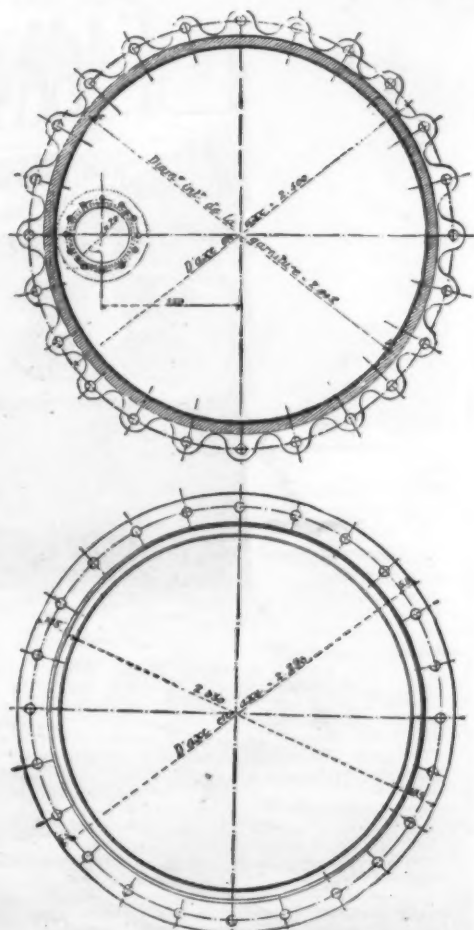

FIG. 2.—VERTICAL SECTION OF THE HYDRAULIC PRESS.

FIGS. 3 AND 4.—HORIZONTAL SECTION AND PLAN.

prolongation of each of the canals, and let us close the gates of the chambers and canals, so as to completely isolate the chambers, and nothing will occur to disturb the equilibrium of the system, which latter will remain immovable. If we now open the valve between the two presses, the upper chamber will descend, while the lower will rise, and this motion will go on until the two chambers are on the same level. At this moment the two chambers will be in the middle of their travel, and in equilibrium upon their presses, the latter containing the same height of water. In order to force the chamber that was on a level with the upper canal to descend, it is supercharged in the beginning with a weight equal to that contained by a press, instead of giving it the same quantity of water as the lower

that have hitherto been constructed. They are to be 6·75 feet in internal diameter, and their pistons are to have a travel of 43 feet, and are to operate under a normal pressure of 25 atmospheres.

The intention in the first place was to construct these presses of cast iron of a thickness of 4·8 inches, but the Administration of Bridges and Roadways, fearing that there would be danger in causing the cast iron to resist traction only, required the thickness to be made 5·6 inches and the cylinders to be surrounded by iron hoops sprung on hot. Things were at this point when the Anderton accident happened, the two presses of that elevator, 3 feet in diameter, breaking during their usual operation without an accident occurring to ex-

corresponded to from 44,000 to 48,400 pounds to the square inch, while according to tests the breakage should only have occurred toward 73,500 pounds. Such a solution of the problem was therefore abandoned.

Afterward an endeavor was made to construct the presses of riveted iron plate, a cylinder being made 6¾ feet in diameter and 6½ in height, of iron one inch thick. This was tried under pressure. When a pressure of 30 atmospheres was exceeded, the joints got out of shape and numerous leakages occurred. Strength had been secured, but tightness was wanting.

Then attempts were made to employ welded steel plates, but these gave no satisfactory result.

IV. In the presence of this difficulty, it was thought necessary to divide the problem into two parts, viz., first, to make a strong press, and, having done so, to provide it with a non-resistant but flexible and tight lining. In this solution, for which the Society has taken out a patent in France and other countries, the press consists of non-welded rings of rolled steel, 6·75 feet in internal diameter. Each of these has, in section, the form of a rectangle 2·16 inches in thickness and 5·3 in height (Fig. 2). The quality of the steel is such that it should not break under a traction of 88,000 pounds per square inch, or present at the moment of breaking an elongation less than twelve-hundredths of its primitive length. The rings are simply superposed, and, in order to prevent them from moving laterally, their edges are rabbeted.

It is easy to see that with this quality of steel, and with these dimensions, such a press might be able to resist a pressure of 300 atmospheres.

It now remains to secure tightness. To this end, the interior of the press is invested with a copper lining $\frac{1}{16}$ inch in thickness, which is applied to the sides with a mallet, and which has its upper and lower extremities turned back so as to be held between the end rings. In this way the water submitted to pressure meets no
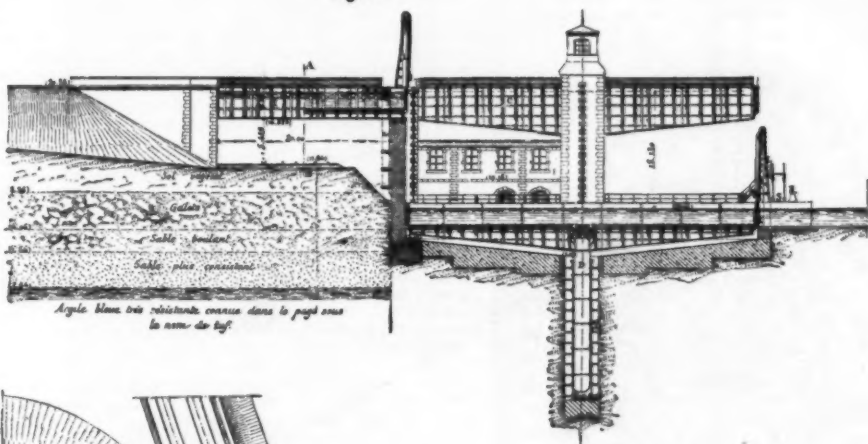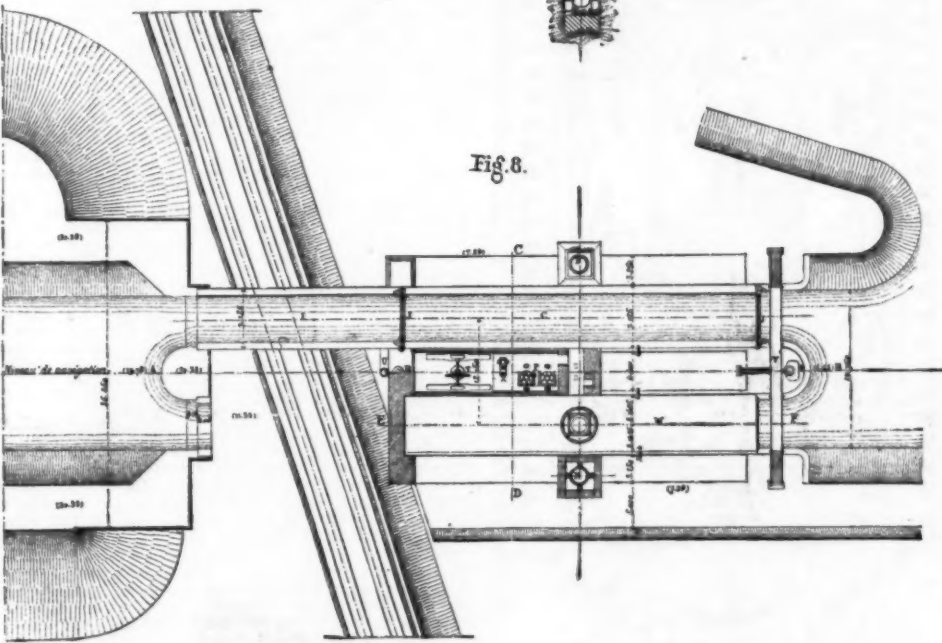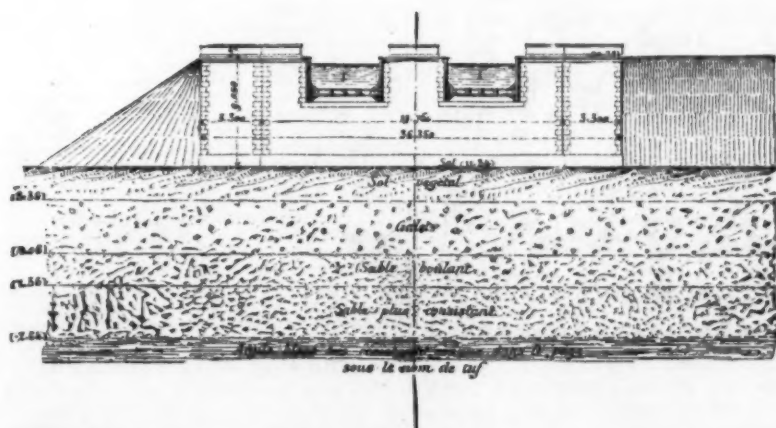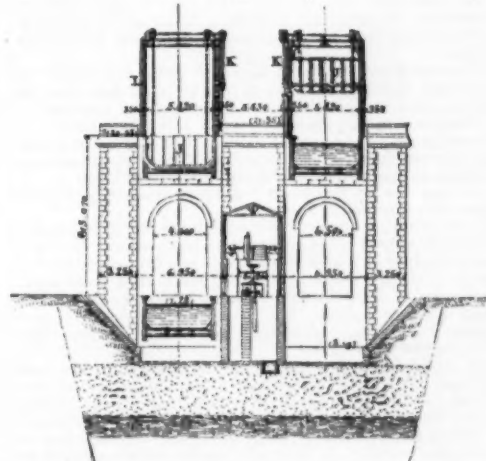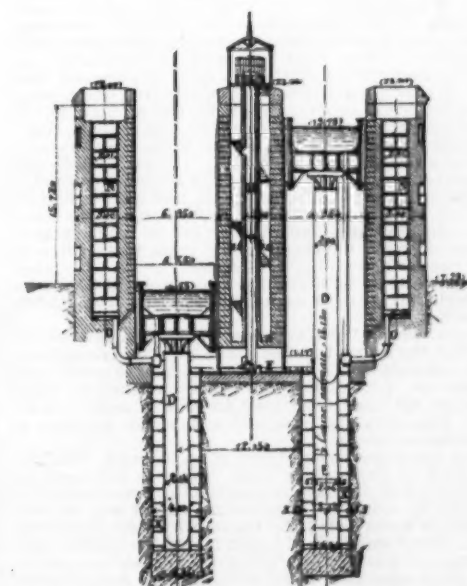

Fig. 5.

Fig. 8.

Fig. 6

Fig 7

Fig 9

FIG. 5.—Longitudinal Section through E F. (Scale $\frac{1}{110}$.)   FIG. 6.—Section through A B.   FIG. 7.—Section through C D.   FIG. 8.—Plan View.   FIG. 9.—Section through the Axes of the Presses.

THE FONTINETTES ELEVATOR.

chamber, so that, instead of stopping in the middle of its travel, it pursues its way until it has reached the lower canal.

Such is the mechanism of the hydraulic elevator which is being constructed at Fontinettes, the details of which are shown in Figs. 5, 6, 7, 8, and 9.

III. It results from what precedes that the elevator is a sort of hydrostatic balance formed of two lock chambers mounted upon the pistons of two large hydraulic presses. The construction of the chambers offers no remarkable peculiarity, they consisting of a framework of iron whose different parts are calculated according to known rules of resistance. The presses, on the contrary, are to be twice the dimensions of any

plain it. It was, as Mr. Seyrig has observed, a new proof of the principle so generally admitted at present, that cast iron is a detestable material to submit to tension, and that it is necessary to avoid using it under such circumstances, even at the cost of the greatest sacrifices. This opinion was likewise that of the Administration, which therefore invited the Societe des Anciens Etablissements Cail to see what improvements could be introduced into the elevator under consideration, in view of the Anderton accident.

In the first place, cast steel free from blisters was thought of, and a large number of rings was cast from this metal, and one of them, taken at hazard, was submitted to a test. This broke under a pressure that

joint through which it can escape. The upper and lower rings, of forged steel, are held together by tie-bars. The stability of this construction is perfect, and the press, which rests upon the ground, has to support merely a moderate longitudinal stress (almost null) for which the tie-bars are more than sufficient.

In order to permit of this project being judged of, a trial cylinder 5·9 feet in height was constructed, which consisted of steel rings like those just described, and which was lined with copper $\frac{1}{16}$ of an inch in thickness. This was tested in the presence of a number of noted engineers. The pressure was raised in the interior of the cylinder up to 170 atmospheres without a trace of leakage being observable, and without the metal of the

rings showing, through permanent elongation, that the limit of elasticity had been reached.—*Le Genie Civil.*

Description of Figs. 5 to 9.—A, upper canal ; B, lower canal ; C, movable lock chambers ; D, plungers that support the chambers ; E, large presses ; F, connecting pipe ; G, sliding valve ; H, transmission for the valve ; I, stationary aqueducts ; J, lifting gates ; K, presses of the gates ; L, gate supports ; M, channel for the lock chamber ; N, compensating reservoirs ; O, pipes between the compensators and compensators ; P, accumulators ; Q, automatic safety apparatus connected with the sliding valve ; R, hydraulic capstans ; S, guide pulleys ; T, machines for submitting water to pressure ; U, canal through which the water makes its exit ; V, foot bridge ; X, press cylinders ; Y, maneuvering room ; Z, clearing pump.

CONSTRUCTION OF STABLES.*

THE United States Census of 1870 gave the number of horses owned in the United States as 8,690,219. When the census of 1880 was taken, there were 12,170,296 horses, mules, and asses on the farms alone. Our own State of Illinois leads with 1,146,360 !

Anything affecting the monetary value of this vast multitude is of importance to the individual owner, to the State wherein he resides, to the nation of which he is a citizen!

We appeal in vain to history to inform us when mankind first subjected this, the most noble of the brute creation, to his service in times of peace and times of war. The date is lost even to tradition, but that he served in the dawn of mankind, the sublime words of Job bear witness:

"Hast Thou given the horse strength? Hast Thou clothed his neck with thunder? Canst Thou make him afraid as a grasshopper? The glory of his nostrils is terrible. He paweth in the valley, and rejoiceth in his strength; he goeth on to meet the armed men. He mocketh at fear, and is not affrighted; neither turneth he back from the sword."

Prescott tells us of his service with the Spaniards in their conquest of Mexico. In short, the debt of humanity to this noble animal cannot be overestimated, and every language has been used to sing his praise!

The artificial restraint imposed upon the horse by mankind during so many centuries past has had its effect, and he resembles his master in many diseases.

From a sanitary point of view, late years have witnessed great advancement in the construction of buildings for mankind, and the cry for better stable accommodations has not been uttered entirely in vain.

Permit me to quote a few from the many writers upon this important subject.

John Stewart wrote: "Stables have been in use for several hundred years. It might be expected that the experience of so many generations would have rendered them perfect. They are better than they were some time ago. . . . A damp stable produces more evil than a damp house. . . . Since 1788, when James Clarke's work was published protesting against close stables, there has been a constant outcry against hot, foul stables. Every veterinary writer who has had to treat of diseases has blamed the hot stables for producing at least one-half of them." Jennings wrote: "The most desirable thing in a stable is ventilation. A horse requires air equally with his master; and as the latter requires a chimney to his sleeping room, so does the former." Henry W. Herbert, better known as Frank Forrester, wrote: "In a climate so uncertain, changeful, and in which the extremes of heat and cold lie so far apart, as in this country, the question of stabling is one of paramount importance. The stable, to be of real utility, must be perfectly cool, airy, and pervious to the atmosphere in summer; perfectly close, warm, and free from all draughts of external air, except in so far as shall be needed for ventilation, in winter; perfectly ventilated, so as to be pure and free from ill odors, ammoniacal vapors, and the like arising from the urine and excrement of the animals, at all times perfectly dry under foot, and well drained, since nothing is more injurious to the horse than to stand up to its heels in wet litter. . . . Lastly, it should be perfectly well lighted as well as thoroughly aired."

Stonehenge wrote: "The horse, like all the higher animals, requires a constant supply of pure air to renovate his blood, and yet it must not be admitted in a strong draught, blowing directly upon him, or it will chill the surface, and give him cold. . . . By common consent it is allowed that no stable divided into stalls should give to each horse less than 800 or 1,000 cubic feet."

Youatt wrote: "It is not generally known, as it should be, that the return to a hot stable is quite as dangerous as the change from a heated atmosphere to a cold and biting air. . . . It is the *sudden* change of temperature, whether from heat to cold or from cold to heat, that does the mischief, and yearly destroys a multitude of horses."

One more quotation from John Osgood, who, in speaking of city stables, said: "Now, in the name of humanity and ordinary commercial thrift and sagacity, let this be stopped. There is no reason why stables should be horse hells! No reason why they should vie with 'The Black Hole' in their inevitable cruelty, and gloom, and destruction. These and city stables generally (with some exceptions) are a disgrace and a shame to a civilized community. So long as they continue as they now are, horses must die. There are no remedies for the sudden and violent diseases which will attend such poisonous air, and water, and food. The remedy lies in providing ample and well-ventilated stables—stables well lighted, with stalls of ample dimensions, with escape pipes for the ammoniacal effluvia which arise from so many animals and their excretions, with more room for evaporations; and then the chances would no longer be against every horse who passes through these doors, as they were against those ghastly ones who passed through Dante's gate, and as they went in read above their heads:

'Who passes here goes into everlasting hell.'

"Improve the stables, then, and prevent disease. . . . Do not insult a respectable animal who has come from the country to do his share of the work of the world, and has brought with him the memory of

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* A paper read July 15, 1884, by Augustine W. Wright, Member Western Society of Engineers.—*Amer. Architect.*

the sweet hills and skies, at least, by immuring him in one of those cramped, rickety, rotten, stinking, slovenly, damp dungeons, where a dumb beast would lose his self-respect and his courage beneath an oppressive weight of miasmas and hideous, gloomy, nasty confusion. Stop this, or pray that horses may die ere the evil days come."

The above, if it have weight, must convince you that badly constructed stables are responsible for many, very many, of the diseases among horses. The paramount importance of abundant sunlight, perfect sewerage, and good ventilation is now, fortunately, recognized almost universally in building human habitations, but how often ignored in providing quarters for the horse, the number sick and unfit for duty most eloquently testifies.

I will now describe a stable just finished for the North Chicago City Railway. It fronts south 125 feet

SUGGESTIONS IN DECORATIVE ART. — EMBOSSED CHAIR LEATHER, CASTLE TRAUSNITZ, LANDSHUT.

upon Belden Avenue, east 238 feet upon Jay Street, both of which streets are 66 feet wide. Along the west side there is an alley 16 feet wide, and 50 feet left vacant, extending to the car-house. On the north our property extends 12 feet beyond the stable. We, therefore, have light and ventilation upon four sides. The horses face north and south. In the rear of each row of horses there is an alley extending clear across the stable, 10 feet wide, with a sash door 7'x10' at each end. Another alley 9 feet 6 inches wide extends the length of the stable at right angles to the former, with sash doors 7'x10' at each end. The stalls are 9 feet deep, and each horse is allowed 56 inches of width. Double stalls are, in my opinion, the best, when horses will stand quietly together. So many of our horses will not do this, that I alternate two single stalls with one double stall, thus allowing the foreman to place the horses who will not stand quietly in single stalls. The floor of this stable consists of 4 inches of asphalt with 2"x4" scant-

ling bedded therein, 16-inch centers, to which the wearing floor of 2-inch pine is spiked. The stalls have an inclination of 2 inches, terminating in a gutter connected with the sewer. These gutters are covered with cast-iron plates 56 inches long by 6 inches wide, perforated to allow the urine to pass into the gutter. These covers are movable, and at least once a week the foreman of the stable sees that they are taken up, and that the gutters are thoroughly cleaned. Some disinfectant should be freely used. Between each row of horses there is a "feed alley" 4 feet wide. By this construction the horses are not brought head to head to breathe each the other's breath, contaminated, it may be, by disease, which is thus spread from one to another. No food is wasted in placing it in the manger; and there is less danger of an employe being injured, or perchance crippled for life, by some vicious or frightened horse. At each end of these feed alleys windows are placed containing 32 lights, 9'x14', a size of glass I have adopted as a standard, and use whenever possible, to avoid carrying a stock of different sizes. In these feed alleys, beneath the floor, there are placed fresh-air ducts, extending from outside to outside of the stable, through which air is admitted, passing out into the stable through perforations in the cover, thus avoiding injurious draughts. Its exterior openings are protected by cast-iron grates built in the brickwork, preventing the entrance of all vermin, and especially the pestiferous rat! In this stable there are nine ventilators, one located at the intersection of all alleys, for the exit of foul air. They are 6'x6' at the lower end, and taper to 4'x4' at the top, extending 8 feet above the roof. The four sides above the roof are movable (except the posts), inclining at an angle of 45°, thus deflecting the air upward, and doing away with all downward currents, and permitting the opening to be reduced in cold or inclement weather, ropes extending to the ground floor for this purpose. We are indebted to the veteran in horse-railroad matters, John Stephenson, for this admirable idea. It resulted from many experiments made by him upon ventilation while a member of the New York School Board. The gas-burners located under these ventilators assist in ventilation by heating the air, which ascends and increases the outward-bound current of impure air.

The first story of this stable is 16 feet high, second story, 7 feet at walls, and 9 at center. Each horse has 1,216 cubic feet of space, an amount fully equal to modern theoretical requirements. The hay-loft can contain one year's supply, if needed. The feed department, with bins for storage, troughs 16 feet long, 4 feet high, and 3 to 4 feet wide for mixing feed, cut-hay room, and horse-power to run the cutter, is located up stairs. As we use shavings for bedding, and can obtain them cheaply and abundantly in summer when the mills are busy, whereas they are scarce and high in winter, the bedding room is large. On the ground floor it is 16'x50', and extends open to the roof, with an addition, 16'x70', on the second floor. The cost of bedding for the horses purchased in this way is one-half cent per diem each.

The hospital, separated from the balance of the stable, is located at the north end, in the most quiet spot. Scales are provided, upon which all supplies are weighed. An office for the foremen, room for grooms, another for conductors, and one for storage are furnished, besides convenient closets, etc. I neglected to state that a number of catch-basins are provided to retain all shavings and solid matter that might otherwise get into and obstruct the sewer-pipes. These basins are 4 feet in diameter, and are cleaned out as often as may be necessary. They are trapped to prevent sewer-gas from entering the stable; all the roof water is used to flush these sewers. The building will be whitewashed in the fall, for health and comfort.

The above brief description will serve to give you an idea as to how far I have succeeded in putting in practice the requirements of theory. The stable has abundance of fresh air, contaminated air is removed, and there is good sewerage and plenty of light. The small percentage of horses in our hospitals most emphatically indorses the construction.

I think with Youatt that the stable should not be too warm in winter. Nature is a safe guide, and she provides the horse with a suitable covering. The stable temperature, in my opinion, should not vary more than 10° or 20° from the external air. Keep the stable cool, and, if necessary, throw a blanket over a horse while hot, just in from work, during severe winter weather. Our car horses pass twenty of the twenty-four hours in the stable, and the importance of thorough sanitary arrangements is, of course, thereby increased, as the majority of horses used in other lines of business spend scarcely more than one-third as much time in the stable.

"A merciful man is merciful unto his beast," but the most refined selfishness, if intelligent, should cause each and every one with capital invested in horse-flesh to give it "suitable stable accommodations." Were my pen capable of expressing all I feel, most eloquent would be my appeal in behalf of the noble brute for whom I have ever entertained the deepest affection.
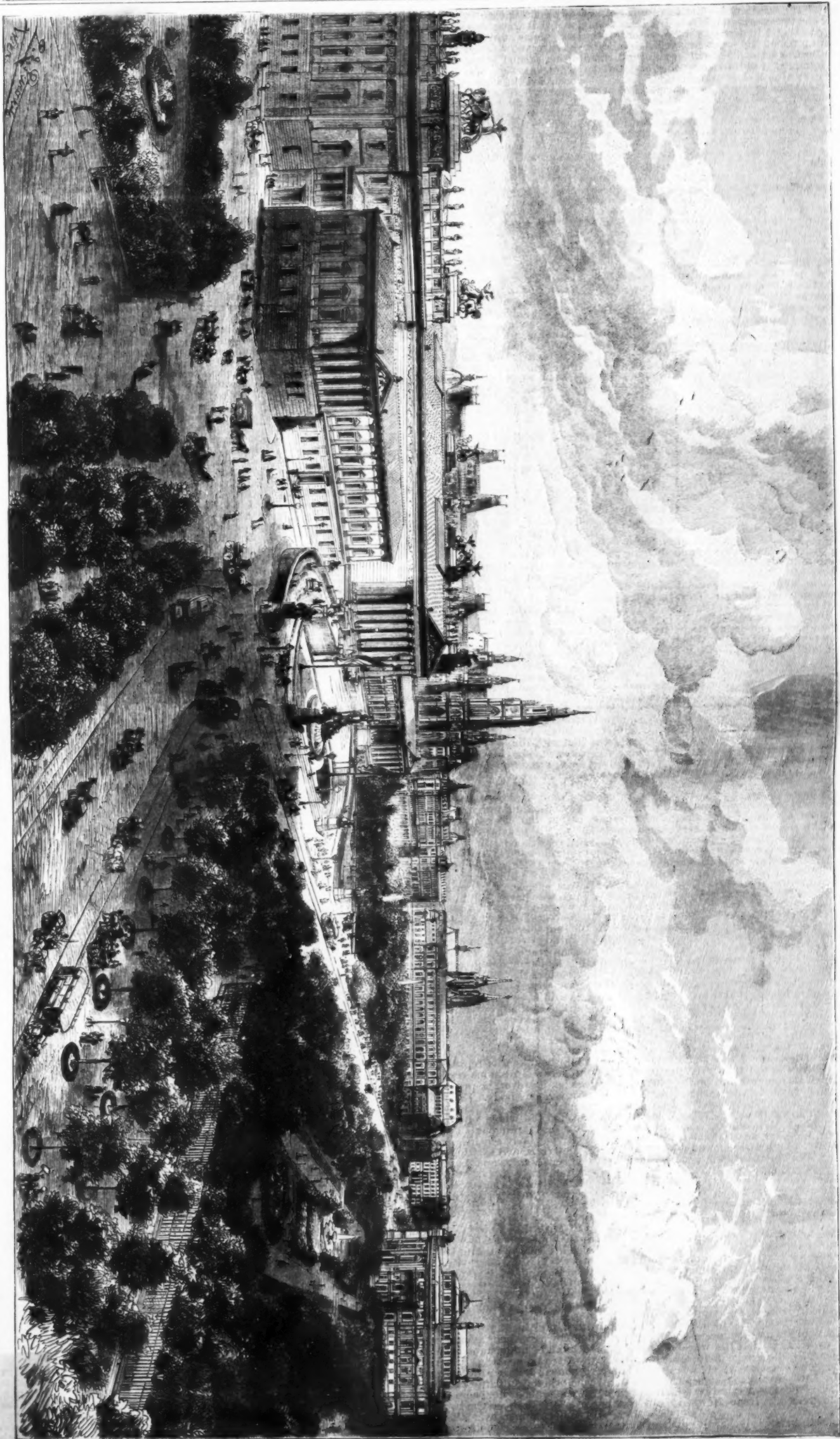
THE CITY HALL PARK AT VIENNA.

THE City Hall Park, or Square, at Vienna has been declared the handsomest in the world; but if it is not the handsomest, it certainly is the grandest forum of its kind. The park is located in the middle of a large parallelogram, at the two ends of which the House of Parliament and the University are situated. The right hand side is bordered by the elegant Ringstrasse, and at the left hand side the beautiful new City Hall is located, flanked at the right and left by grand private dwellings. The new Imperial Court Theater is located opposite the City Hall and on the opposite side of the street. Each and every building is perfect in itself, and each is a masterpiece of architecture. The University is built in the style of the Italian Renaissance, the Houses of Parliament are of the pure Grecian style, the City Hall is modern Gothic, and the Court Theater a brilliant Renaissance of the finest period. The towers of the Votive Church, appearing in the distance, are also Gothic.

These different styles of architecture destroy the uniformity of effect produced, and tend to bewilder. Furthermore, the main facades of the University and Houses of Parliament do not face the City Hall Park, but the Ringstrasse, so that only the less elaborate

CITY HALL PARK, VIENNA.—DRAWN BY L. E. PETROWITSCH.

sides of the above mentioned buildings form part of the forum. The two enormous private dwellings flanking the City Hall tend to destroy the character of the square, and in place of the same some official building should have been erected. Notwithstanding all these defects, the square is grand and imposing, and the defects appear only after a close examination.

Ten years ago the ground now covered by these beautiful buildings was used as a parade ground for the garrison of Vienna, and the military authorities refused to permit their parade grounds to be used for city improvements, but had to yield to the imperative orders of the Emperor. The city of Vienna, in former years, was a fortress surrounded by enormous walls and moats, outside of which the nine suburbs were located. About twenty years ago the city walls were taken down and the moats filled, whereby a tract from one-quarter to one-half a mile wide was formed around the inner part of the city; and on this tract the well known Ringstrasse, the Natural History and Historical Museums, the Votive Church, the Exchanges, the Opera House—destroyed by fire a few years ago—the New Opera House, the City Hall, University, Houses of Parliament, Imperial Court Theater, and many private dwellings, palaces, buildings for the several departments, banks, etc., were erected ; large tracts being reserved for parks.

The previous page, representing the new City Hall Park, is from the *Illustrirte Zeitung*.

SOURCES OF ELECTRICITY.

THE first of a course of six lectures adapted to a juvenile auditory, by Professor Tyndall, on " The Sources of Electricity," was lately delivered at the Royal Institution, London.

Professor Tyndall, in opening the course, said he knew that the delivery of such lectures caused pleasure to others besides himself. It was a pleasure to his colleague, Professor Dewar, and to their noble and good master, the late Professor Faraday, who in the later years of his life lectured to no one else but to those whom he loved to call the juveniles. Nine years ago he (Professor Tyndall) undertook to lecture upon the subject of electricity to boys and girls in that institution. At that time he took what he now called friction electricity, and he devoted the whole of the six lectures to that subject. His intention now was to give them a connected story, so to say, from beginning to end—commencing with the smallest germ, and showing them how it grew up until it had reached the development of the present time.

Many of them were aware that the name of this electricity was derived from the fact that first facts were observed by the ancients in the attraction of light bodies by amber. Amber was called, as many of them knew, electron—hence the name electricity, that was, that wondrous power of attraction which amber at first exhibited. It might be mentioned that amber was still found in various parts of the earth. It was found in Europe, especially along the shores of the Baltic, particularly after storms, when it was cast upon the waves and gathered there. There were also beds of fossil trees. In point of fact, along the shores of the Baltic the amber tree in distant times bloomed ; and just as the poplar at the present time oozed out its gum, or the pine tree its resin, so the amber tree in those days dropped its precious gum into the sea ; and where the amber had fallen and could be converted into lignite, they there found the amber diffused among the fossil amber trees.

The ancients had another story about amber. They considered it a very costly ornament, and paid dearly for it ; and, indeed, at the present time, the revenue derived from the sale of amber is very considerable. The ancients told them that the daughters of the sun, for some reason, were converted into poplars, that these poplars wept tears at their sufferings, and that these tears, petrified, became amber. They would find the account in Sir George Cornewall Lewis' History of Ancient Astronomy. He would begin with the first experiment made with amber. He held in his hand a piece of amber made into the form of a stick consisting of the two mouthpieces of pipes fused together. By means of this stick he would show them the attraction of light bodies by amber. Rubbing the amber with catskin, he showed how some bran was attracted by the amber. [Experiment.]

The human mind was never contented with merely looking at a thing and seeing that thing occur; they were never contented with facts. Therefore, at an early time, the question occurred, Why did amber attract light bodies ? The ancient philosopher was following the irresistible profundity of the human mind when he asked the reason of this. He supposed the amber to possess a soul, and in virtue of this soul attracted these light bodies. This was the theory of the celebrated Newton, the great astronomer and philosopher. There were various other ways of showing this attraction. For instance. [Experiment.] He placed a lath upon a point, and showed how a glass tube, after being rubbed as he had rubbed the amber, acted upon the lath. He ought, however, first to have stated that this attraction of light bodies by amber was the only thing known to the human mind for 2,000 years. Not until the year 1600 was the bond pierced by the celebrated Dr. Gilbert in the time of Queen Elizabeth. Dr. Gilbert said, "If you look at amber, it is a kind of gum. You see insects sometimes entangled in it. It would be very extraordinary if this were the only thing capable of attracting light bodies."

Dr. Gilbert therefore set to work, and found a vast number of other substances attracting light bodies, like glass, for instance, in its action on the lath in the experiment he had shown. They might use sealing wax instead of the glass tube he had used. The lecturer then, to illustrate this, showed several other experiments with a watch glass, an egg, a piece of sealing-wax, and a small wheel. He wanted to impress on them the quality of what was called a scientific mind. It had the quality of looking behind facts. They would observe in the experiment that the wheel followed the glass tube about as a carriage followed the horses harnessed to it. The question which a scientific mind asked was, " Is there anything between the glass tube and the wheel?" That was a question which occupied the mind of the great Sir Isaac Newton as to gravitation.

He asked himself, "How is it that the sun can control the earth in its orbit ?" He was too cautious to express any definite opinion on the matter, but his conclusion was that there was something there which enabled the sun to act upon the earth. In the same way he (the lecturer) now asked them this question—whether anything existed between that wheel and the glass tube ? That question was one of the most important that occupied the minds of scientific men. They wanted to know whether there was a medium between that glass tube and that wheel. It was, as he had said, a point which was occupying the minds of scientific men, and perhaps they would not solve it in our day. Another experiment was made with regard to attraction by Sir Isaac Newton, who was a great experimenter as well as a great mathematician, and he was very much taken by this electrical attraction. He made this experiment: He wore a dressing gown; he got a plate of glass, and placed light bodies, such as bran, over that plate of glass, on which rested a ring of brass, placing over it a plate rubbed against his dressing gown.

Projecting the shadow of the brass upon the screen, the lecturer showed this experiment, and how the bran was acted upon. Incidentally he drew attention to the arrangements he had provided for keeping out of the theater all vapor and moisture, the arrangements being, he observed, to secure dryness, and not warmth or heat. Passing on to the laws of this attraction which they had just seen, he said he would give them an experiment which was first made by a sturdy old fellow, the burgomaster of Magdeburg, in Prussia, Otto Guericke, who invented the air pump. He noticed that when one brought an electrified body to and near a suspended feather, one saw it attracted there. He noticed after it was attracted, and after it touched the attracted body, that it was repelled. [This experiment the lecturer then showed, using the glass tube before mentioned.]

He might, he explained, use sealing-wax, or shellac, or a variety of other bodies. Showing how the feather was drawn toward a stick of gutta percha, and driven away by a glass tube, he stated that in this exhibition they had the first notion of the difference between electricity on the surface of the glass and upon the surface of gutta percha. The one attracted, the other repelled, the feather. He would now show them an experiment which he himself first made that morning, guided, of course, by the principles of electricity. They had seen him, he first observed, communicate the electricity upon the surface of the glass tube to the feather, and that when the feather had upon it the same electricity as the glass tube, the feather was repelled.

Taking a stand and resting it upon the table, he remarked that he wanted something to interpose between the stand and the table, which would not allow the electricity to pass from the lath placed upon it to the table. He found this something in a piece of shellac, but he might use common resin, or sealing-wax, or India rubber. He would, however, use the shellac, and he now knew that any electricity he might communicate to the lath would be prevented from going to the earth. He was forestalling matters a little, but in a few moments they would understand all he was saying. The experiment would be attended with some risk, as when he first made it that morning he wore a different coat, and he did not know whether the coat he was wearing at that time would behave as the coat he wore in the morning did.

He then requested his assistant (Mr. Cotterill) to strike him with the catskin, thus electrifying him. At the same time he drew his hand over the lath, explaining that in that way he was communicating to the lath the same electricity that Mr. Cotterill was exciting upon his body. They would observe how the lath followed his hand—a movement he afterward stopped, observing in continuation that he had communicated to the feather the electricity upon the glass, the self-same electricity proving itself repulsive. In the same way in the experiment he had just given, the electricity communicated to his hand had caused his hand to repel the lath. He would ask them to go fully into this matter with him, because it underlay the whole of electrical science. Sir Isaac Newton found his dressing gown was better for his glass than other substances. It was soon found that the electricity excited depended a good deal upon the rubber—a towel would not excite the same electricity as a catskin.

Taking two sticks of sealing-wax, and balancing one on the cradle, he rubbed the second stick, and showed the attraction and afterward the repulsion of the two substances electrified in the same way. He subsequently repeated the experiment with two pieces of gutta percha, and said he might go on with sulphur and sulphur, two paraffin candles, or paraffin and wax, or he might take ebonite and ebonite. Taking an ebonite comb, he passed it through his hair, and then showed how it repelled another ebonite comb, which was balancing in the cradle. Sealing-wax was a common substance, and might be taken as representative of the whole class of the so-called resinous bodies. Taking a stick of gutta percha, however, he proceeded to show the effect on it of a vitreous body. [Experiment shown.] Instead of repulsion, they saw powerful attraction. He might go through the whole of these bodies, and in each case show that a resinous body repelled a resinous body, and a vitreous body repelled a vitreous body. Suspending a glass tube, and exciting it by rubbing it, he took another glass tube, and having rubbed it, demonstrated the repulsion of the one from the other. Having repeated the experiment with two sticks of sealing-wax, he placed the glass tube in the balance, and showed the attraction between it and a resinous body—a piece of the sealing wax.

He wished them to bear in mind that they were here at the fundamental law of electricity—like electricities repelled each other, unlike electricities attracted each other. The terms " vitreous " and " resinous " electricities were at the present time abandoned, and the electricity developed by glass they called positive electricity, the electricity developed by sealing-wax and the resinous bodies being called negative electricity. There was, however, no reason whatever why one should be called positive and the other negative; it was simply done by agreement among scientific men, in order that they might understand each other when they talked of positive and negative. He next showed two pieces of ribbon electrified alike " standing at utter enmity to each other; " and afterward placed a sheet of paper on a wooden board. There was not, he said, the least attraction between the two, but having passed a stick of India rubber over the paper, he showed that he required to use some force to get the paper away from the board.

With two slips of paper he next illustrated the law that similar electricities caused repulsion. Several strips of paper suspended and insulated were then brought forward by the lecturer's assistant, and the former rubbed a glass tube and held it toward the strips, which at once commenced to diverge from each other entirely, owing, the lecturer observed, to the repulsion of the same kind of electricity. Calling attention next to the electroscope, he cast its shadow on the screen behind him, showing two pieces of gold leaf suspended. He then placed two balls, separated, on stands, took an arch of thick copper wire, and made the distance between the two balls sufficient to enable him to span them with the arch. Neither ball, he explained, had any power of attraction at present, but having communicated electricity to one of them by means of a glass tube, he spanned the two with the arch of copper wire, and showed how the electricity from the one was thus communicated to the other ball. This had been done by what was called a flow of electricity, and hence the motion of an electric current. To illustrate this principle still further, he attached a piece of copper wire to the arch, connecting it with the electroscope; and having touched one of the balls with the arch, he showed how a portion of the electricity thus communicated to the ball went through the wire to the electroscope, making the pieces of gold leaf diverge considerably.

By means of a further experiment, he caused the gold leaf again to collapse, and resume its former position. Detaching the piece of copper wire from the arch, he replaced it by a piece of dried twine, and having electrified the ball as before, showed that the twine had no power to conduct the electricity—a power, however, which he afterward showed was possessed by ordinary undried twine. He wished to impress on their minds in a manner never to be forgotten the influence of moisture. The dried twine was rendered an insulator; the ordinary twine was a conductor. He repeated this experiment with a piece of silk, first in a dry and afterward in a wet or damp state, and showed that in its former condition it was an insulator, while in its moist state it conducted the electricity. In the early part of his lecture he had spoken of the tendency of the human mind to inquire into the hidden causes of things; and as to these phenomena, those hidden causes were entirely beyond the range of sense. They must be seen by the scientific intellect. He wished to give them an idea of a notion long entertained by scientific men regarding electricity. There were two kinds, they said, positive and negative; and they further said that these positive and negative electricities were mixed together in all bodies.

He must now come to what he called a very beautiful experiment, which occurred to him two days previously. [Experiment shown on the screen.] In front of the lamp they had a brass ball suspended and connected by wire with a cylinder of brass. Mr. Cotterill would place upon that some loose bran, and then they would see what would occur. He would excite his glass tube, which he then passed over the cylinder. This glass tube would attract the negative electricity, and the other electricity, the positive, would flow toward the brass ball, and if it reached the ball and electrified it, the bran underneath ought to jump up to it. In this experiment he had not touched the cylinder with the glass tube. Supposing, however, he touched the cylinder before he brought the glass tube to bear upon it, they would see that there was no jumping of the bran. Why? Because the positive electricity, instead of going to the bran, had flowed through his body to the earth. The moment he removed his hand the liberated positive flowed toward the bran, which they saw jumping again. With this experiment the first lecture of the course was concluded.

ON PERSONAL SAFETY WITH ELECTRIC CURRENTS.

By Professor A. E. DOLBEAR.

THE serious accidents which have occurred within the past four or five years through accidental contacts with wires carrying strong electric currents have seemed to call attention to the necessity of providing safeguards against such mishaps. It is probable that carelessness has been the cause of most of the accidents reported, and it is true that if weak currents only were used nobody could be hurt. It is, however, worth while to consider the electrical relations of the human body in order to learn where danger lies. I have noted in various places the opinions of different persons as to what constituted a safe current. In one of the old books it is stated a " spark 18 in. long begins to be dangerous." In another place one says that a difference of potential of 800 volts is too high an electromotive force for individual safety.

Now a difference of potential of 1000 volts will not give a jumping spark the hundredth of an inch long. The electromotive force developed by the Holtz electro-machine may be as high as 50,000 volts, and the spark from it will at most give a spasmodic jerk to the elbow, and no manner of hurt come of it or of repeated shocks from it, so that more than difference of potential must be considered in determining what is dangerous about electricity. The ability of electricity to do work of any kind, destructive physiological work as well as any other, depends upon both difference of potential and current strength, and the amount of work is proportional to the time also. Now the discharge from a Holtz machine through a short wire may give a very strong current ; for example, let E = 50,000 volts, R = 0·001 ohm, then $\frac{50,000}{0·001}$ = 50,000,000—fifty millions of amperes ; but the wire may show no sign of being injured, for the time of the current passage was too short, probably less than the millionth of a second. If the discharge had continued for an appreciable part of a second the wire would have been vaporized. The discharge is probably equally quick when taken on the knuckles, but there is not enough energy to hurt anything. Again, the amount that will traverse any conductor, with a given difference of potential between its ends, will vary inversely as its resistance, and for the human body it may only roughly be calculated. The resistance of the body is very great. Many measurements made with different individuals taking wires in their fingers and hands, give a resistance varying between 6,000 and 15,000 ohms ; but this depends in a large degree upon the moisture of the skin when con-

tact is made. Hands which are ordinarily dry have a high resistance ; the same hands moist with perspiration or purposely wetted may lose half their resistance. Dr. Stone, of London, has made many experiments, and finds that the resistance of the body may be reduced to 500 ohms or less, by having the skin soaked. On an arc light circuit with forty lamps the difference of potentials will be about 2000 volts. If a man with a dry, thick skin were to grasp the terminals at the dynamo, the current that would go through him would be $\frac{2000}{10000} = 0.2$ of an ampere, and in one second two-tenths of a coulomb would have traversed his arms. If the same hands were soaked, the current might be $\frac{2000}{500} = 4$ amperes, or 4 coulombs per second. In the first case there would have been spent in him an amount of energy equal to $2000 \times 0.2 = 400$ watts, or more than half a horse-power, and in the second case $2000 \times 4 = 8000$ watts, or $\frac{8000}{746} = 10$ horse-power in the interval of one second. Now, any electromotive force above about 1.5 volts is sufficient to decompose water, and it has been shown that the fluids of the body are better conductors of electricity than any of the tissue, even the nerves ; it may fairly be inferred that such a current with such an electromotive force might decompose a notable quantity of the fluids of the body into their constituent gases.

To determine the highest limit of safety would require experiments which no human beings would be willing to submit to. Animals might be employed perhaps ; but if 800 volts have at any time proved to be dangerous, one may set a lower limit to the resistance of the body and determine the current strength $\frac{800}{1000} = 0.8$ ampere. That result looks threateningly large, but it is because the resistance is made so low. I have never found one less than 5000 ohms, then $\frac{800}{5000} = .16$ amperes. But that represents 128 watts—a quantity of energy no one would care to have spent in him. After all, what would be safe for one would be entirely unsafe for another ; so that each individual would have his own factor of safety, or the difference of potential which he could work with, with impunity. From what we now know, it would seem as if one-tenth of an ampere current body was as much as any one could safely have traverse his body for one second. If, then, he fixes his minimum resistance, the product of the two will give him the electromotive force which he may feel timidly safe with. Thus, if one's resistance with wet hands is found to be 8000 ohms, then $8000 \times 0.1 = 800$ volts ; while if his resistance was only 1000 ohms, he could only venture to touch wires having a difference of potential of $1000 \times 0.1 = 100$ volts. The ordinary incandescent light circuit would be on his limit.

ELECTRO-CHEMICAL RINGS COMPARED WITH THOSE OBTAINED BY PHYSICAL, MECHANICAL, OR CHEMICAL WAY.

I.

WHEN a plate of glass that has been regularly compressed around its circumference or at certain points is placed between an analyzer and polarizer, we observe
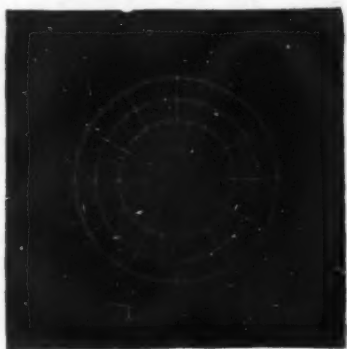

FIG. 1.

through its substance concentric iridescent waves which are the more marked in proportion as the compression has been stronger. What is remarkable is that these optical rings are like those that are produced upon plates by making them vibrate under a fiddle stick after covering their surface with fine sand. The figures thus obtained with circular plates always exhibit rings mixed with radiating lines of more or less regularity, while with square plates circular figures are quite rare.

Colorations analogous to those of annealed glass are again produced by the bending of a plate of glass, or by an expansion or a sudden cooling of the glass in a metallic frame, and by the hardening of fish glue in

FIG. 2.

glass moulds—the observations being always made with polarized light.

It occurred to Nobili to compare electro-chemical rings with the acoustic figures of Chladni, Paradisi, and Savart, but no result was obtained.

In my hydrodynamic experiments, similar to those that I performed upon the vibratory forms of plates, I have had an opportunity to establish several analogies between such figures and those obtained by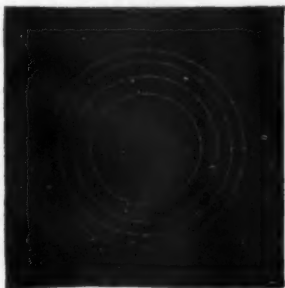 electrochemical way. Figs. 1, 2, 3, and 4 represent the comparative f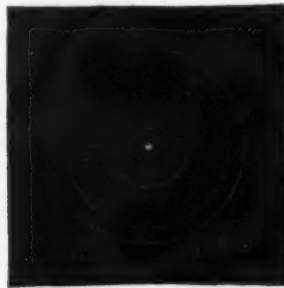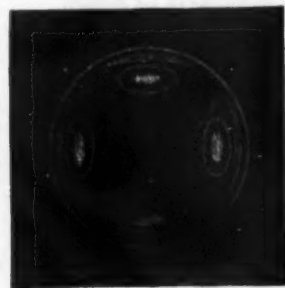orms of the rings that are produced under corresponding conditions. The analogy between these four is evident enough. I might have joined thereto the thermic and chemical rings, which are very similar

FIG. 3.
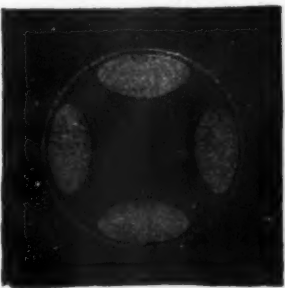

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

in form and color to the electro-chemical ones. Fig. 1, which represents electro-chemical rings with radiating lines, requires an explanation, since Nobili's rings have no radii, a fact that seems to establish an important

FIG. 9.

difference between them and hydrodynamic rings. Nevertheless, under special conditions, it is possible to ascertain the presence of radiating lines in electrochemical rings. In fact, Mr. Guebhard has remarked

FIG. 10.

that upon employing very thin silvered sheet copper for the production of these rings, we observe white filaments running from the circumference of the latter to the center, if the point is negative. These filaments,
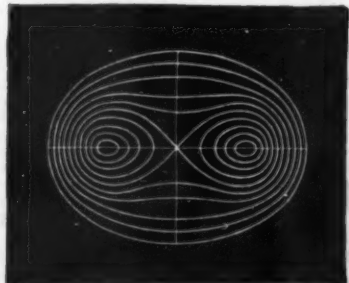

FIG. 11.

which are nothing else than very fine bubbles of gas derived from the electrolysis of the liquid, correspond to the radii of our hydrodynamic rings.

Figs. 5 and 6 exhibit quite a remarkable approximation between the optical colored rings obtained by

means of annealed or compressed glass, and the acoustic figures obtained upon vibrating glass covered with a thin stratum of water containing red lead in suspension. During the vibratory motion, the water assumes the form of a regular network, with meshes of varying size,

according to the diameter of the plate. When the vibrations cease, the red lead deposits, and preserves in doing so the form of the liquid network. After the evaporation of the water, the deposit adheres to the

plate, and copies may be taken from it just as with an ordinary photographic negative.

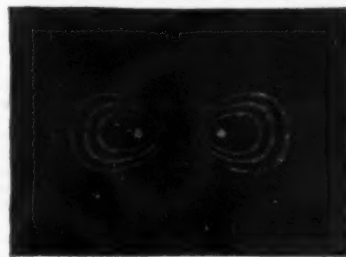Figs. 7 and 8 exhibit an analogy of another order.

FIG. 12.

The optical figure, 7, whose six equidistant radii are iridescent, was produced by diffraction, while the light
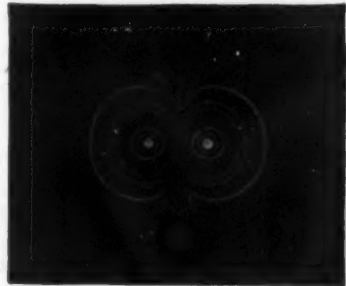

FIG. 13.

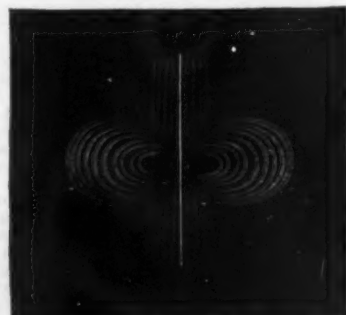was passing through a small aperture having the form of an equilateral triangle. The acoustic figure, 8, was

FIG. 14.

produced upon a vibrating plate besprinkled with sand. The six radii represent the lines of rest, and the nodes those of vibration.

Figs. 9, 10, and 11, to which might be joined their analogues among the thermic and chemical rings already

described, show the relations of form and color between electro-chemical, hydrodynamic, and optical rings. Fig. 11 represents the colored rings (of Herschel) in crystals of two axes arranged between two tourmalines. These rings are distributed over curves of two centers. Figs. 12, 13, and 14 show the comparative forms of electro-chemical, chemical, and hydrodynamic rings.—*C. Decharme in La Nature.*

CENTENARY OF THE LONDON TIMES.

The Times was founded on the 1st of January, 1785, as the *Universal Register.* It received its present name on the appearance of its 940th number on the 1st January, 1788. The exact wording of the original heading was "*The Daily Universal Register*, printed logographically by His Majesty's Patent," which was subsequently modified to "*The Times* or *Daily Universal Register*, printed logographically."

John Walter the first, or the founder of the Walter family, of whom the present Mr. John Walter is the fourth in direct lineal succession, was born in 1738. His father was a coal buyer, that is, he bought coal at Newcastle on a large scale, brought it to London by sea, and disposed of it there. He died in 1755, leaving his son 17 years of age. This son, whom we will call John Walter the second, became in ten years the chairman of the wealthy and influential body of coal buyers, who had built for themselves a Coal Exchange under his supervision. He married in 1771, and five years afterward became a member of Lloyd's, and carried on the business of underwriting. He rapidly accumulated money, and was on the high road to fortune, when a fleet of merchantmen on which he had taken a large risk was captured by a French squadron. His loss amounted to £80,000. He wrote and published a pamphlet setting forth his misfortunes, expecting to receive either compensation in money or a place under Government, in which, however, he was disappointed. In 1782 Mr. Walter made the acquaintance of Henry Johnson, a compositor, who had made what he considered to be great improvements in the art of printing. Mr. Walter was impressed with these improvements. He contributed to complete them, and became, together with Johnson, a patentee of printing by means of logotypes. In 1784 he took the premises, then vacant in Printing House Square, where in 1666 John Bill had founded and printed the *London Gazette*. The well known name Blackfriars is derived from a monastery of Black Friars, which formerly occupied that site. Mr. Walter, of course, was not a printer, but he labored hard and successfully to qualify himself for the business in which, as he wrote, he had embarked as a mere novice. Hence, he says, want of experience laid him open to many and "gross" impositions. However, he abounded in enthusiasm and perseverance. He was confident that logotype printing would effect a revolution, by which both the nation and he would profit, and founded the newspaper now known as *The Times*, to prove that newspapers as well as books could be printed far better and more cheaply than by the system in common use. We need not explain to our readers that the logotype system consists in using whole words or parts of words cast in one piece, instead of single letters. The idea has always commended itself to non-practical people, on the ground of its apparent simplicity and the economy of labor which it appears to promote. Mr. Walter took counsel with Sir Joseph Banks, then President of the Royal Society, and received his approval in the most emphatic terms. The new system was pronounced to be a most useful acquisition to the literary world, and deserving of the highest encouragement and support from the public. Mr. Walter corresponded on the subject with Benjamin Franklin, the celebrated American "printer and patriot." Franklin also looked with favor on the new system, and as he was not only a 'shrewd man, but a practical printer, his good opinion carried great weight. Not merely did Walter hope to economize in printing, both as regards time and cost, but he also anticipated a great extension of the art by the use of logographic types. In the *Universal Register* for the 12th of August, 1786, he announced that, having established a type foundry for casting logographic types, he was "able to supply any gentleman with logographic types who may have reasons for executing any work of secrecy or amusement, as the types of the words are so easily used in preference to single letters, and consequently the knowledge of printing may be acquired with facility. The experiment already made by a nobleman of the first rank and abilities, both in station and knowledge, fully evinces the truth of what is asserted." It is probable that the Duke of Portland is the nobleman here referred to, he having handed to the King a copy of Mr. Walter's pamphlet on logographic printing.

In addition to setting up his newspaper with these types, Mr. Walter used them in his general printing business, and a large number of books issued from his logographic press. No less than fifteen of these works appeared between the years 1784 and 1790, but the system had to be abandoned at last. It had several practical and insurmountable drawbacks, one of these being that the cases to contain the different sorts were too bulky and cumbersome, while if the cost of composition were less, that of correction was very much greater. We may here remark that many years later an effort was made to revive the system. Major Beniowski, an ingenious and plausible Pole, made some changes in it for which he procured letters patent, and he obtained the assistance of Captain John Greene, for many years member for Kilkenny, in furthering and advocating it. In 1854 Captain Greene succeeded in getting a Select Committee of the House of Commons to investigate the matter, and he did so, despite the opposition of Mr. Gladstone, then Chancellor of the Exchequer. The report of the committee was to the effect that as the evidence was conflicting, no decision had been arrived at concerning the scheme. *The Times*, which had suffered severely from the delusion of logographic printing, naturally wrote in condemnation of Major Beniowski and his invention. From time to time various schemes of a similar nature have been propounded, and they may all be said to have been failures. There is, however, reason to believe that if a few of the more common affixes and suffixes used in the English language were placed in ordinary cases, their use might effect an appreciable economy.

Not long after the *Universal Register* became known as *The Times*, it ceased to be printed by logotypes.

The first number under the new name, which appeared on the first of January, 1788, contained an address to the public on the subject of printing, wherein Mr. Walter returns thanks for the reception accorded to efforts to improve that art. He states that he purposes issuing a pamphlet detailing his grievances, and gives as a specimen the fact that being in want of apprentices, he sent an advertisement asking for them to the *General Advertiser*, which was "generally read by the lower orders of the people," but that Mr. Jenour, the printer of the paper, refused to insert the advertisement after taking the payment for it. It is probable that the readers of Mr. Walter's paper cared little for his disputes with rival printers, and were lukewarm supporters of his inventions. They had a clear piece of evidence against the success of the new system. The *Universal Register* was sold for 2½d., being a ½d. less than any contemporary, the reduced price being said to be a proof of the saving effect of the new plan, whereas the price was raised to 3d. when the paper assumed a new name.

The first number of *The Times* was a folio sheet of four pages, of which more than one-half was filled with advertisements. A column and a quarter, headed "The Times," contains a statement as to the change in the title and an exposition of the policy of the paper.

The success of *The Times* was not rapid. In 1786 Mr. Walter had to pay a fine of £150 for a libel, and three years after he was sentenced to a fine of £50, to stand for an hour in the Pillory at Charing Cross, to be imprisoned in Newgate for twelve months, and to find security for good behavior for seven years after leaving prison, for a libel on the Dukes of York, Gloucester, and Cumberland. As a specimen of the disgraceful severity with which printers were treated in those days, we may say that the libel consisted simply of the remark, which was probably well founded, that these royal dukes were "insincere in their profession of joy at the King's recovery." When in prison, two other libels were laid to his charge. He was accused of publishing that the Prince of Wales and the Duke of York had demeaned themselves so as to incur the just disapprobation of His Majesty, and that the Duke of Clarence had returned home without authority from the Admiralty or his commanding officer. Mr. Walter was brought from Newgate on the 3d of January, 1790, to receive sentence for these additional heinous offenses, and for both libels he was sentenced to a year's imprisonment in Newgate, to date from the expiry of the year he had to serve, and to pay £200. After being in prison sixteen months, he was liberated on the intercession of the Prince of Wales. The result of this treatment was that he was so disheartened as to contemplate giving up *The Times*, and confining himself to printing and publishing books. The journal was conducted at a loss, and to be subjected to fine and imprisonment in addition to losing money by the journal was as trying to his temper as to his pocket. Instead, however, of discontinuing to publish *The Times*, Mr. Walter wisely associated his eldest son in its management, and in 1803 made him sole conductor.

JOHN WALTER THE THIRD

was born in 1776. He studied at Oxford with a view of entering the Church, but at his father's request he abandoned his original intention. He had been regularly apprenticed to his father, and had mastered the art of printing. It was for the purpose of giving *The Times* another and a last chance that John Walter III. was admitted to a share in its management. He had the great qualification, in addition to remarkable natural gifts, of a thorough acquaintance with the details of printing and publishing. He was twenty-seven when he undertook the sole management of *The Times*, and this was the beginning of its prosperity and the true source of its fame. He found it a struggling and feeble journal. He left it the most successful and powerful newspaper in the world. On obtaining the power to give effect to his policy, he set himself to reorganize the staff of *The Times*, to do everything he could to accelerate the production of the paper, and to fill it with fresh and trustworthy intelligence.

In those days 4,000 copies constituted a large circulation for any newspaper. The story of Mr. Walter's enterprise in obtaining and publishing the earliest information cannot be gone into here, although it would constitute one of the most interesting chapters in the history of modern British journalism. Reverting, therefore, to the typographical aspect of the subject, we may mention an incident which took place toward the end of May, 1810. It was a danger which threatened to shipwreck the result of Mr. Walter's incessant labors. The pressmen in the office made a demand for increased wages. As hand presses were alone used, the services of these men were indispensable. At the same time the compositors combined to demand not only higher wages, but the disuse of a new size of type, which had then been introduced. The men bound themselves by an oath to be united and firm in demands to which they considered that resistance was hopeless. Mr. Walter had a private intimation of the strike a few hours before it took place on a Saturday morning. Hastily collecting a few apprentices and unemployed compositors, he worked continuously for 36 hours along with them in preparing the Monday's issue, which to the astonishment of the workmen on strike appeared in the usual course. During several months the business of printing the journal was conducted under difficulties; the workmen on strike molesting those employed in the office. The lives of the latter were often in peril during the struggle. At length it was resolved to prosecute the men on strike for conspiracy as well as for illegal combination, the result being that 21 were put on their trial at the Old Bailey, on the 8th November, 1810, that nineteen were found guilty of conspiracy, that two ringleaders were sentenced to imprisonment for two years, three others for eighteen months, three for twelve months, and eleven for nine months.

Not long after this Mr. John Walter the second died at Teddington, on the 16th of November, 1812, in his 74th year. He had prospered as a printer and publisher, and left the journal, which by this time had become a very valuable property, to his son, John Walter the third.

The circulation was largely increased and the necessity began to arise for a more expeditious method of producing the journal. The ordinary printing appliances of the time became altogether inadequate to provide the copies for which there was a demand. Mr.

Walter had made several attempts to effect improvements in the printing press. He consulted Marc Isambard Brunel, who was one of the great mechanics of the day, but he was unable to execute what was required. Mr. Walter advanced money to a Thomas Martyn, who thought he had made an important discovery, but his ideas were not realized in practice. While engaged in seeking for a person who could give scope and effect to his wishes, Friedrich Koenig, a German, who was born in Saxony in 1774, was laboring to effect improvements in the printing press. He was confident of substituting steam for manual labor in his new press, and was anxiously waiting for an opportunity to give scope to his views and for a patron to countenance and promote them. We need not here recount the history of the origin of the steam printing press, more especially as Koenig's invention has been often described. Suffice it to say, therefore, that under the auspices of John Walter the third, and through his advice and pecuniary assistance, Koenig's presses were made practicable and set to work in *The Times* office. Rumors of the new invention were circulated despite the secrecy to which all concerned had been pledged, and *The Times* pressmen, who believed that their means of livelihood would be at an end when steam was applied to printing, vowed vengeance upon the inventor. The new press was erected in rooms adjoining those wherein the old presses were in operation. At six o'clock in the morning of the 29th of November, 1814, Mr. Walter entered the office with several damp printed sheets in his hands, and informed the startled pressmen at work there that *The Times* was already printed by steam, that if they attempted violence there was a force ready to suppress it, but that if they were peaceable their wages would be continued to every one of them until similar employment could be procured. In proof of his statement, he handed them copies of the first newspaper which had issued from the steam press. The readers of that day's *Times* were informed of the revolution of which it was a visible token.

From the day of *The Times* being printed by steam down to the present day, unceasing efforts have been made with a view to perfect printing machinery. Mr. John Walter the third died in 1847, in his seventy-second year. He had not only built up a great journal, but he had established a great personal reputation. He sat in Parliament, and acquired much wealth. He left behind him estates in Berkshire and Wiltshire, the freehold premises in Printing House square, the interest in *The Times*, which represented as valuable a property as many large landed estates, and personalty to the amount of £90,000.

JOHN WALTER THE FOURTH.

In order that the journal might retain its position, it was necessary to introduce constant improvements in the mode of its production. It was found that notwithstanding the improvements made by Applegath on Koenig's press, the improved press was inadequate for the work required. Mr. Applegath then designed one on a different model, which sufficed for a time. In this press the types were placed on vertical cylinders, and these revolved a thousand times in an hour, throwing off 8,000 copies. This press was shown at the Great Exhibition of 1851. About the time Mr. Applegath completed this press here, Mr. Hoe was introducing the lightning press in New York. Two of the ten-cylinder or largest size were bought by Mr. Walter. Meanwhile Mr. Walter encouraged the late Mr. Dellagana, the founder of the present firm of Dellagana and Co., Limited, to prosecute his experiments in stereotyping by the papier mache process. This was adopted in *The Times* office in 1850, and the speed attained with the Hoe press was 12,000 copies an hour.

THE "WALTER" PRESS.

It had been seen, however, that vast improvements might yet be made in rapid newspaper printing, and this notion was realized when the "Walter" press was devised and put in operation. To Mr. John C. MacDonald, for many years a distinguished member of *The Times* staff, the "Walter" press largely owes its origin and success; while in giving effect to the inventor's scheme the present Mr. Walter exercised the same judicious supervision and liberality for which his father was noteworthy. This press is the subject of four letters patent, issued between 1863 and 1871, to John Cameron MacDonald and Joseph Calverley.

TYPE-SETTING BY MACHINERY.

Mr. Walter did not rest satisfied with having at his hand a press of such perfection as that which is called by his name. He resolved to simplify and accelerate the process of setting up type also, and in this respect his success has been marked. After many experiments the machine of Kastenbein was chosen, but on its shortcomings being made apparent, great efforts were made for its improvement. A number of composing machines are in use in the office regularly, and a large portion of *The Times* is set up by means of them.

We have only space to devote a very few lines to the editorship of *The Times*, which if the subject were looked upon from another point of view would, of course, be regarded as of greater importance than the mechanical matters to which we have hitherto confined our attention. Mr. Walter the second, its founder, was proprietor, printer, and editor. Mr. Walter the third was editor as well as conductor, and to him is attributable the introduction of the leading, or more correctly the "leaded" article, which has become the distinguishing feature of the newspaper press. For seven years, however, he employed Mr. Barnes as editor. Mr. John Thaddeus Delane succeeded Mr. Barnes in 1841, and filled the editorial chair for thirty-six years. He was succeeded by Mr. Thomas Chenery, who, however, did not long fill the editorial chair, as he died after a short illness on the 11th of February, 1884. His successor is Mr. G. E. Buckle, who now occupies the position.

No paper in the world is so faithfully edited as *The Times*. So careful was Mr. Delane, however, to gain every possible information upon any given subject, that he would give a commission to half a dozen persons to write him a leader, all of whom would receive five guineas, though perhaps not half a dozen lines of the contributors had been used. It is on such occasions that the editor's abilities are so wonderfully disclosed. Mr. Delane would look at the several copies he had received, and would take a portion out of each, but his mind was so well organized that the *creme de la creme*

alone found space. The mighty editor of *The Times* has, it is said, a salary of £5,000 a year; the editors and sub-editors, whom he controls, to a certain extent, are numerous and well paid. There is what is called the Foreign editor and his sub-editor, who are generally all but linguists. They examine with the minutest care the telegrams which arrive from abroad, put in a little of their experience of the country and the proceedings; with them is associated an officer perhaps of high degree, at least one well versed in military affairs, who can denounce the strategies or admire the policies of commanders in chief or other officers, and on the strength of the combined opinion of several learned in war out comes *The Times* leader.

Again, there is the City editor, as he is called, who attends the Stock Exchange day by day, and with several assistants gives full particulars of the changes in the money market, the value of securities, and even the rumors that are afloat, giving favor neither to bulls nor bears, but often influencing the market. *The Times* comments upon Stock Exchange business influence the world. Those who contribute to the money column of the journal are paid well, and it is quite right that they should be well remunerated, as none but those who have their heads screwed on the right way could obtain the information they do, and more than this, they have to mix in the best society. There is also the Sporting editor, who culls for *The Times* pleasant information, and when he gives horse-racing news, there is nothing "horsy" or vulgar about the report. Again, there is the chief sub, who has to take in hand the "flimsies," assisted by two and sometimes three sub-subs—who knock out, rewrite, and polish up a penny-a-liner's copy sometimes so that the original writer can scarcely discover which is his own and what is written for him.

It is difficult to draw the line between the editorial staff proper and those who are constantly engaged to write upon any given subject. For instance, perhaps sixteen leader writers present themselves in one evening to take orders from their chief. As each in his turn puts in an appearance, he is asked questions concerning his knowledge of some current topic, and ordered to take a particular line of argument, but always that nearest akin to truth. "I think we can do without you to-night," the editor may say to one, and to another he will give this leader or that to do, or he may take the cumulative ability of several individuals on one special leader. Genius is soon discovered, and *The Times* always respected, because the editor will have attention paid to a good article, which must not be thrown in the wastepaper basket as at other offices. The Honorable Robert Lowe used frequently to send leaders when not in office. Whether as Lord Sherbourne he contributes now, deponent knoweth not, but his articles were brilliant effusions at one period. Beyond those we have enumerated, there are several all-round men employed on *The Times* who can be sent off at an hour's notice to any quarter of the globe. Their war correspondents, for instance, are paid enormously, and are enabled to draw *carte blanche* upon the office for their expenses. Soldiers to this day feel grateful to Dr. Russell and *The Times* for the assistance afforded them in the Crimean war. While the official report represented the soldier's body well sustained and well sheltered, Dr. Russell boldly depicted his miserable condition, and *The Times* printed it. An unofficial report was before this period presented to the military authorities before being dispatched, but Dr. Russell would none of this. The sympathy of the nation was roused, and food and clothing were dispatched by the charitable public, and want and misery were relieved.

"THE TIMES" SUPPLEMENT.

It may surprise some people to know that there is an editor, a sub-editor, and a full staff engaged to bring out *The Times* Supplement, which is not allowed to interfere with the getting up of the text for the ordinary sheets, and if any one were behind the scenes and saw the tedious work of classifying these advertisements, he would be astonished. In consequence none are taken in after four o'clock P. M. A stupendous affair is the editing, printing, entering, etc., advertisements when there is a double sheet. The proprietors are very independent; only as a favor will they accept a full page advertisement, and for that the advertiser must pay a hundred pounds down, and with the distinct understanding that no special day can be promised, but it shall appear within a fortnight. This supplement is, of course, the backbone of the paper, and is said to produce thirty thousand pounds sterling per annum.

No men on the working staff of a newspaper are paid so well as those on *The Times*, and, as a body, no men so efficiently perform their duties. Most of them have been called to the Bar, and all of them are thoroughly educated men. When Parliament is sitting, there are twenty-one members of the staff engaged in reporting—nine shorthand men who write out verbatim in the Commons, and nine in the Lords, with a summary writer in each House and one chief superintendent, who directs the corps. The summary writer's notes are conveyed by telephone every quarter of an hour, and set up as they are received. These notes are given to the editor, who sees what is going on, and has his leader written accordingly. Besides this corps, men are wholly or partially employed in courts of law, etc., to the number of a dozen, making a staff capable of performing any possible speed, and giving verbatim speeches from half a dozen places at once, as in the time of an election. A wonderful corps *The Times* possesses, and no reporter gets less than seven guineas a week, many of them rising by gradations to ten guineas a week.— *Colonial Printer.*

TO DESCRIBE A RIGHT ANGLE ELBOW CONTAINING ANY ODD NUMBER OF PIECES.

DRAW the indefinite right angle line *a b c*, with *b* as a center, and, the compasses set any convenient distance, check the right angle, as at *d* and *e*. Mark the right angle *d e f*, and make *e f* equal to diameter of elbow. Erect the perpendicular *e g*, making the distance equal to *e f*, and draw the lines *g h* and *f o*, at right angles to *e g* and *e f*. Draw the rectangle, as Fig. 2, equal in length to the circumference of elbow, and in width the distance from *f*, to point of intersection on line *g h*, in Fig. 1. Describe the semicircles *a b* and *c d*, dividing them into any equal number of parts, and from the points of intersection draw the parallel lines 2, 3, 4, etc.

Draw the line *e f*, bisecting the rectangle, and divide each half into as many equal parts as the semicircle *a b* contains, and draw the perpendicular lines at right angles to *d b* and *c a*. A line traced through the points of intersection will form a three-piece pattern. Fig. 3 represents a sheet of metal marked from the pattern, and cuts without waste. Allow for lap and cut out. For five pieces, with *e* in Fig. 1 as a center, cut the line

Fig. 1

Fig. 2

Fig. 3
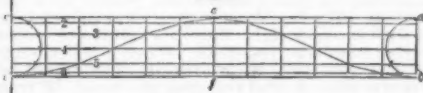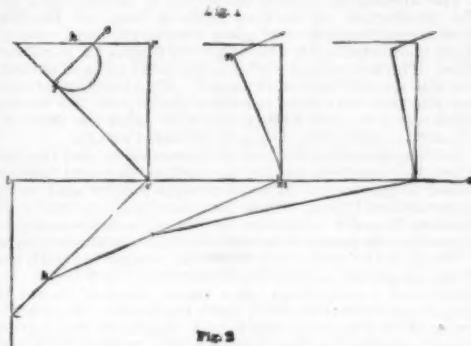
e d, as at *k*, and the line *b c*, as at *m*, and proceed as before. Proceed in the same manner for seven, nine, and any odd number of pieces.—*S. A. Niarf, in Tinner.*

WOOD WOOL.

ALTHOUGH this product (so called because it consists of very fine shavings derived from wood) has for the last four years been in extensive use in America, its use in Europe has been limited. It is but recently that it has been decided to employ it, not only for packing, but also for stuffing mattresses, and as a substitute for rags in cleaning engines, and for filtration, etc.

As waste wood of all kinds may be employed for manufacturing the article, and as the machines that produce it are capable of making, according to the fineness that it is desired to obtain, as much as a thousand pounds a day, it may be correctly asserted that wood wool, as compared with hay and straw, is the cheaper article for packing purposes. On another hand, hay and straw are often damp, and it is rarely the case that the former does not contain the stiff stems of plants.

As a material for stuffing bedding, harness, and upholstery, wood wool comes next to hair as regards elasticity; and it is even preferable to all other materials when it is derived from resinous wood, in that it absorbs no moisture and keeps away insects. After numerous trials, which have demonstrated the value of the article, several hospitals have adopted it as a stuffing for bedding, cushions, furniture, etc.

The accompanying engraving shows a machine constructed by Messrs. Anthon & Sons, of Flensburg, for the manufacture of it.

The frame is of cast iron, and can, if need be, be placed in an inclined position. The driving shaft carries a fast and loose pulley upon which the belt runs, and a handwheel which at the same

time serves as a crank. The connecting rod actuates a carriage provided with very simple tools—a wide plane iron and a series of small knives. These latter are spaced according to the width of the shavings that are to be formed, and are placed slightly in front of the plane. The wool produced by this combination drops under the machine. The wood to be worked is held by two toothed rollers which revolve to a slight degree backward at every travel of the carriage. One of these (the one nearest the shaft) bears constantly against the wood through the action of a counterpoise mounted upon a small hand wheel, so that the wood is firmly held and undergoes a forward motion every time the tools pass. A lever fixed to the small hand-wheel permits of giving the rack of the pressing roller a more rapid to and fro motion.

One boy suffices to run the machine, his duty being limited to introducing the pieces of wood under the rollers, one after another, as soon as he has started the machine by shifting the belt to the fast pulley. As soon as the wood is set, it is no longer necessary to hold it, and so, if the pieces that are used are not *too* small, one boy can easily attend to two machines.

The product of this machine is about a thousand pounds per day of twelve hours, in ratio inverse the fineness of the wool that it is desired to obtain. The width of the wood may be varied at will on varying the spacing of the small knives. The motive power absorbed varies, according to the production, between that of one and two horses. The machine works up round, square, or flat wood indifferently, but the length of the billets should not exceed twenty inches, and the width six.—*Moniteur Industrielle.*

SUMAC.

THIS term is commonly applied to the dried leaves of a number of American and S. European plants, from all of which tanniferous extracts may be obtained. The main members of this class are the following: The European or Tanner's sumac, found in Sicily (*Rhus coriaria*); in Tuscany the same variety is found, and is often adulterated with the leaves of *Pistacia centiscus*; in the Tyrol the Venetian sumac (*Rhus cotinus*); in France the species *Coriaria myrtifolia*, which is classed in four divisions, viz., *fanois, douzère, redoul* or *redou*, and *pudis*; in Algiers the so-called sumac of Tesera (*Rhus pentaphylla*), the leaves of which are employed in making Morocco leather; in North America the white sumac (*Rhus glabra*), the Canadian sumac (*Rhus canadensis*), the hartshorn sumac (*Rhus typhina*), and the black sumac (*Rhus copallina*). All these are found wild in their respective countries and districts, and are also cultivated in many, but more especially in Sicily. *Rhus glabra* and *copallina* are chiefly cultivated in the United States of America. The kind of soil usually selected for the cultivation of these plants is mostly very poor, although a firm, rich, and deep layer of mould yields a much more plentiful crop of leaves, of superior quality. In Italy it is considered that a soil with abundance of lime is the best for growing sumac, whereas the American sumacs are said to flourish best in sandy and clayey soils. The first point to be attended to is the drainage, as stagnant water in the neighborhood of the roots proves to be most injurious. The ground is well and deeply plowed, and then shallow trenches 24 in. apart are formed. In Italy holes are made two feet long, seven inches broad, and five inches deep, and at each end a plant is placed. The best method of all is said to consist in forming parallel trenches 24 in. apart, and plowing in exactly the same manner at right angles. A plant is then placed at each crossing point. If the plowing, etc., be done in the early spring, as soon as the earth is dry enough, the expense will not be found excessive. Young plants are taken after being allowed to gain strength on the basis of the older plants of the former year's crop. Plants may also be grown from seed, in which case they become bulkier and more vigorous; but the longer time and additional expense required have also banished this method of growing. Young shoots are the quickest, and usually also give good results. In any case the following points must be attended to in selecting young plants:

(1.) The plants from which they are taken must not be too old.

(2.) They must be above 12 in. long.

(3.) The roots must not be bulky, but the number of root-fibers should be large.

(4.) No silky, white roots can be tolerated, as this is a sign of parasitic growths, either formed or about to do so.

(5.) A good plant will be straight, about half an inch thick and 18 in. long, with an abundance of buds, and a short root.
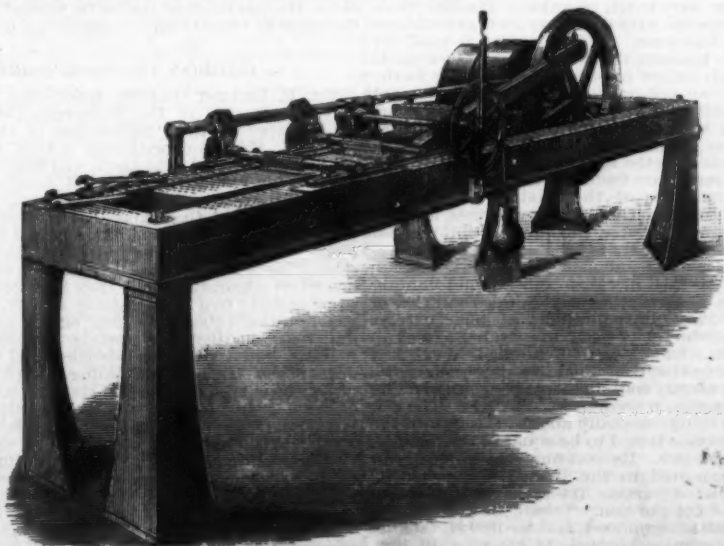
MACHINE FOR MAKING WOOD WOOL.

Suitable plants are collected in autumn, when the leaves begin to fall from the old plants; they are preserved until the next spring, but care must be taken not to allow the root-fibers to become dry. The cultivation of the sumac plant resembles that of Indian grain; an essential is loose soil and freedom from weeds, which are removed by plowing between the rows of plants. The major portion of attention is required during the first year. In the year following that of planting, the first crop of leaves is gathered; it is found that leaves are formed and ripen more slowly with young than with older plants, and in Italy this takes place at the end of August, but much earlier in the United States. Shortly after planting. the shoots are reduced to the height of six to eight inches, and this operation is not repeated even in case of an inferior height being attained. The leaves are mostly collected in winter time. If in the third year young shoots are formed close to the ground, they are removed at an early stage, unless required for fresh plantings, as they weaken the plants. During collection the leaves, with the exception of the youngest, are conveyed in baskets to a drying shed, where they are allowed to dry in thin layers, being constantly turned over with wooden forks. Later on another collection is made of the ripened leaves which have not yet become red, and these are found at the extremities of the plants. This second crop is hastened by breaking the twigs. The material so collected is subjected to identical treatment as the first lot, but always yields a product of lower quality. After the second year a better and larger crop may be expected. The manner of collecting is different, and can be more frequent. In Sicily the leaves are collected both by cutting and by stripping. The former method is cheap and very simple, besides being quick, although the plants are certainly somewhat injured; the second method is slower, but spares the plants, and is conducive to uniform crops. Where cutting is the plan adopted, the lower, older, and riper leaves are carefully plucked during May, and in July all twigs bearing leaves are cut off, leaving merely the bare stem. This operation is not confined to any special time, but depends upon the development of the leaves. When the leaves are dark green, they have their maximum weight, and contain most of their active principle. In Palermo sumac is not cut before June and not later than July. The collection of leaves requires experienced hands, otherwise many plants would be ruined. The twigs obtained are bundled up and pressed into compact heaps, in order better to resist the action of wind and sun. After about 20 days the plants are again stripped very carefully by hand. When the crop is to be got in by stripping, this takes place three times, viz., in May, at the end of July, and in September. During the last collection the twigs are broken, and the leaves removed when dry. When collected, the leaves are dried in the open field, and are then conveyed to the beating sheds.

Rain causes much injury to the leaves, but this may be minimized by stacking them so that air can freely circulate. In the case of twigs this takes place easily and completely. Stirring the heaps is not advisable, as their quality is improved by protection by sunlight. Beating free the leaves from twigs and stems; it should not be done when the leaves are very dry, as, e. g., at noon time, as then an excessive quantity of "sumac flour" is obtained. If beaten when damp and tough, the product is termed "sumac for packing." In the latter case the stems still have particles of leaves adhering to them, and after another thorough desiccation a second beating yields a low quality of sumac, which is termed "gamuzza." The best sumac is worth two and a half times more than gamuzza. To form the various qualities of sumac the same is ground in mills furnished with two grindstones, and much resembling those employed in expressing olive oil. In Virginia the leaves are collected by the peasants and sold to the millers, who try to obtain the largest quantities of the best material at the lowest possible figure, and who do not concern themselves about modes of collection. Wholesale dealers, however, bear in mind the following points: The leaves have the maximum value just before becoming red, when they begin to fade, or have been frostbitten, in which case they are much esteemed for treating leather. Sumac should have at least a month in the drying sheds before being put in the market. Before packing and shipping, the product must be quite dry, as otherwise trouble will ensue in warehousing. The buyers of sumac for grinding value the leaves according to their color, which should be light green. This color shows that the product has not suffered either by rain or by heat in drying. The Virginian harvest comes to from 7,000 to 8,000 tons, and is worked up between July and the commencement of the frost. Chemically and commercially, American and European sumac vary much in value. The European plant yields a product with 6 or 8 per cent. more tannic acid than the American. Sicilian sumac is used for fine white glove leather; the American product yields leather of an ugly yellow color, which according to Dr. Löwe is due to two yellow coloring principles termed by him "quercitrin" and "quercitin." It appears that American sumac contains much more of these coloring matters than the Sicilian. The maximum amount is contained in the leaves in July, and the coloring principles present are found to exercise an important action on the value of the product. The upper leaves are always richer than the lower ones, and the older the plant the less value the product will possess. Sumac collected in August is of low quality; that of June serves for leather intended for delicate shades; and that of July is used in calico printing and tanning and dyeing dark leathers. Messrs. E. Coez and Co., of St. Denis, near Paris, have brought a sumac extract into the market which has been evaporated to a sirup in a vacuum pan. In this case the tannic acid exists in a different state to that contained in a decoction of the leaves. Sumac usually contains 16–24 per cent. of gallic acid, and in its action resembles myrobalans. The district of Ancona brings annually about 200 tons into the market. This sumac is said to be equal to the Sicilian, and is much cheaper. Its consumption is local. In 1877 Palermo exported to the United States 120,043 sacks of "ventilated" sumac (14 sacks = 1 ton) of an average value of £14 per ton. Trieste in 1878 shipped to England 16,660 kilogrammes, and in 1880 91,800 kilogrammes. Rustchuk exported 14,000 tons in 1880, principally to Roumania and Austria. In 1880 England imported over 11,630 tons, worth £145,665, of which Italy alone furnished 10,573.

APPARATUS FOR THE CONTINUOUS PREPARATION OF GASES.

The apparatus which Mr. Gaston Tissandier constructed last year for the production of the gas necessary to inflate his electric balloon gave so good results that he has recently had one made upon a small scale for laboratory use.

The apparatus usually employed in laboratories for the production of various gases is that of Deville. Sometimes two spherical glass vessels are used, one of them connected with the other by means of a rubber tube. The first vessel contains the solid to be dissolved, and the second the active liquid. By lowering or raising the reservoir that contains the liquid, the acidulated water is made to flow out of or enter the first vessel, and a production of gas is obtained at will.

Such apparatus offer one inconvenience, and that is, when the reaction begins to slacken, the acid that is added to hasten it is introduced into a more and more concentrated liquid, which thus acts less and less well. Besides, in order to remove the liquid, it is necessary to interrupt the production and take the apparatus apart.

There are no such inconveniences connected with the little apparatus figured herewith (from *La Nature*). It consists of a cylindrical glass vessel about 24 inches in height, and provided with three tubulures. This, after being filled with zinc turnings, is closed at the top by some impermeable tissue, such as silk coated with balloon varnish. The liquid, consisting of sulphuric acid diluted with seven or eight times its volume of water, is contained in a large reservoir. When it is desired to produce gas, the cock, R, is opened. The liquid descends in the tube, A, and traverses the vessel, M, from bottom upward, and, coming into contact with the mass of zinc, converts the latter into sulphate, which dissolves, while the hydrogen produced makes its exit through the tube, D. When the liquid reaches the middle of the vessel, M, it escapes through the tubulure connected with the U-shaped tube, T. This tube forms a siphon which allows the liquid to flow out, but does not give access to the gas. In measure as the zinc dis-
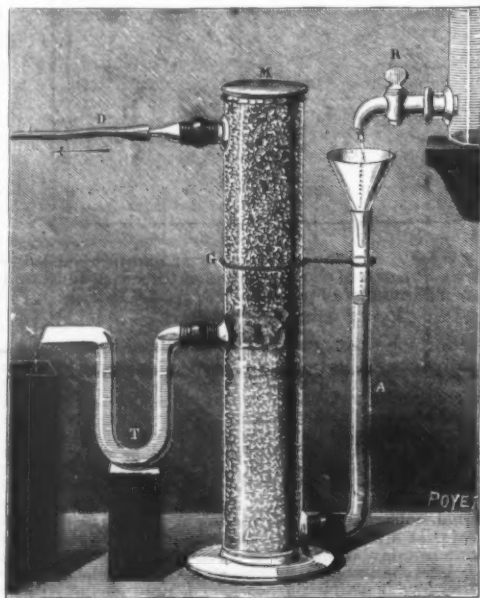
LABORATORY APPARATUS FOR THE PRODUCTION OF GASES.

solves, it is replaced by the reserve portion stored in the upper part of the vessel.

With this apparatus of constant flow, in which the residua are eliminated in measure as they are produced, and in which the active liquid is continuously renewed, the production of gas is very rapid, and, moreover, is easily regulated by the cock, R. When the operation is finished, the cock is closed, and a current of tepid water is passed through the apparatus in order to wash out the sulphate of zinc that might crystallize therein. The reason for using tepid water is that cold water would crack the glass, which has become heated through the reaction. After it has made its exit from the apparatus, the gas must of course be washed and dried just the same as when other apparatus are used.

CARBON IN PHOSPHORUS.

Mr. E. Ernest Graves, before the Chemical and Physical Society of the University College, London, read a paper on the "Estimation of Carbon in Phosphorus." He commenced with a brief history of this subject, and stated that Leeds was first led by theoretical considerations to the belief that carbonic oxide would be oxidized by nascent oxygen; both he and Baumann stated that experiments verified this theory. On the other hand, Profs. Remsen and Southworth asserted that carbonic acid was not oxidized in the slightest degree by ozone. Recently Remsen and Reiser have described apparatus which they have constructed so as to be entirely free from organic matter. It consists in a combustion-tube containing cupric oxide heated to dull redness; then two wash-bottles containing sodic hydrate, and a third wash-bottle filled with baric hydrate; then a bell-jar containing phosphorus in convex disks, the curved surface just showing above a solution of potassic bichromate and hydric sulphate; air was passed in through the copper oxide tube on to this bell-jar, the air being kept as near 24° C. as possible. In this case white fumes were abundant during the course of an experiment, indicating the efficient working of the phosphorus. From this bell-jar the ozonized air was washed by means of a bottle containing pure water, and was then passed into a bottle containing concentrated baric hydrate, and this in turn protected from the external air by a sodic hydrate tube. Air alone, when passed through this apparatus for a sufficiently prolonged period, gave a precipitate—diminu-

tive though it might be—in the baric hydrate solution. Ten liters of air gave a turbidity; twenty to thirty, a precipitate. Phosphorus was considered a likely source of the carbon; for is not phosphorus isolated by methods similar to boron, silicon, and iron, in which carbon occurs as an impurity? Attempts to estimate the carbon in phosphorus at first failed, but the conclusion was arrived at that the carbon *must be* in chemical combination. The carbon has since been quantitatively determined. The method consists in oxidizing a known weight of phosphorus by means of pure hydric nitrate, removing the oxides of nitrogen from escaping gases, and estimating carbonic acid. The quantity of carbon found was about 0·04 per cent. While the absolute quantity is small, it is sufficient to account for the results obtained, and the conclusion is that carbonic oxide is not oxidized by moist air in contact with phosphorus. Since Remsen published the above, Baumann has again affirmed that oxidation does take place, and the matter is now open to other workers to decide.

CARL WILHELM SCHEELE.

By Benjamin Frank Hays, Ph.G.

The old adage that a man is never a prophet in his own country was well exemplified in Scheele's case. It is related that when the King of Sweden came to Paris, at a time when the whole scientific world was ringing with Scheele's fame, he was met on all sides with inquiries in regard to his famous subject; but, to his mortification and disgrace be it said, he was unaware of the existence of such a person, and secretly dispatched a court courier back to Sweden in order to discover who this Scheele was. Carl Wilhelm Scheele was the son of a merchant, and was born in Stralsund, Sweden, in 1742. He received an ordinary school education, and though no doubt an apt scholar, evinced no inclination for the study of the higher literary branches, his inquiring mind being naturally attracted by a love of investigation toward chemistry, and as a means of gratifying this desire we find him at the age of fifteen engaged as an apprentice to the apothecary of Gothenburg.

Let us stop for a moment and inquire into the causes which conspired to lead the apprentice on to those wonderful discoveries upon which his fame shall evermore rest. Like a true child of genius, we find him here viewing the occurrences that transpire in a pharmacist's busy life with open eyes and mind filled with wonder, and it is in these very points that genius gives proof of its genuineness. While the majority of mankind accept facts without endeavoring to substantiate them, and come to regard every-day occurrences as commonplace, genius like a little child asks for the "why," and views the things men call ordinary with amazement bordering upon awe. The great difference between men of genius and ordinary mortals lies in the fact that the latter need sign-posts and lanterns to direct their footsteps, while the former have little use for such aids, and become, as it were, sign-posts and lanterns themselves to the rest of humanity. While millions of people shuddered at the sound of the thunder and hid themselves in dark rooms from fear of the lightning, Franklin went out into the storm and drew electricity from the clouds.

That Scheele was a genius, there is no room for doubt. Perhaps some simple accident in the laboratory first kindled Scheele's enthusiasm, and his ardor once kindled burned with an unquenchable flame, and in order to satisfy this craving for knowledge, having no special time to devote to his favorite pursuit, we find him depriving himself of much needed rest; but to him this was no sacrifice, for herein lay his whole source of amusement and recreation. *Nature is inexorable;* she gives nothing for nothing; she hides her secrets in her bosom, and every fact man wrenches from her is by payment of just so much labor or life. As Longfellow says:

"The heights by great men reached and kept
Were not attained by sudden flight;
But they while their companions slept
Were toiling upward in the night."

While Scheele's comrades were carousing, he was experimenting, and with the lighted lamp of science in his hand mounted the tower of knowledge and engraved his name indelibly upon every step. Of the early details of Scheele's life very little is known. After serving his apprenticeship at Gothenburg he remained at that city for a number of years and while here studied the works of the standard authors of the day, among whom we may mention Lemery, Kunkel, Neumann, and Stahl, and the latter's writings seem to have exerted a great influence over him, as indeed they did throughout the whole civilized world. After leaving Gothenburg, Scheele went to Malmö, and from there to Stockholm, and in 1773 settled at Upsala. During these years he filled the position of assistant in various pharmacies. But while his feet wandered from place to place, his love for chemistry never wavered, and it is largely due to the experiments and investigations that he conducted during this time that a way was opened to those brilliant discoveries that later in life placed him by the side of the ablest men of the day.

At Upsala he received a position in a pharmacy, and while here, through a trifling occurrence, became acquainted with the Swedish chemist Bergmann, who then occupied the chair of chemistry at the University. One day the proprietor of the pharmacy in which Scheele was engaged noticed that when salpeter was heated to a moderate degree it melted, and that if the temperature was raised a copious supply of gas was given off; then when the salt became cold, if acetic acid was added, red vapors were disengaged. He was ignorant of the cause of the reaction, and being acquainted with Gahn, who was then studying at the University, and who afterward became a chemist of note, went to him to seek an explanation; but Gahn knew no more of it than his friend, and he in turn sought Bergmann, who, as an example of the knowledge that then existed among chemists, was compelled to admit that he did not know the cause, when Scheele, accidentally overhearing the conversation, ventured to give an intelligent explanation, and this came to the ears of Bergmann, who expressed a desire to see Scheele, and thus began an acquaintance that lasted through life. Even at this early date Scheele began to develop the characteristic qualities of an experimenter; he was one of the first to make actual investigation take the place of speculation, one of the first to intelligently use reagents,

and with this knowledge was enabled to tell a new body when he came in contact with it ; following up every reaction until he obtained the whole truth, he carefully examined every step of ground he went over, and allowed nothing to escape him, one discovery leading on to others.

His earliest researches, of which I find any account, were made in the domain of organic chemistry, and in these investigations he had no predecessor ; and when we consider the strides he made in this intricate department of science, we begin to form some idea of his genius.

He was attracted to this study by observing that the juices of various plants and fruits were acid, and he endeavored to discover what acid they contained. Now tartar, the deposit from grape-juice, was known to consist of an acid and an alkaline base, but Scheele was the first to isolate this acid, which he obtained in the crystalline state. He accurately studied and described its properties, recognized it to be a new compound, which, on account of its origin, he called tartaric acid.

In unripe apples he discovered malic acid, and was the first to point out the difference between citric and tartaric acids, and to obtain citric acid in a pure state.

Various other plants were known to contain saline bodies, but these were supposed to be one or other form of the combination of mineral acids with alkalies, and the salt was present in rhubarb root was thought to be a sulphate of potash, until Scheele proved it to be an oxalate of lime, and found that many other plants contained it, and published a list of thirty-seven different plants in which he detected this acid combined with either lime or potash.

His mode of ascertaining the presence of oxalate of lime was to macerate the drug reduced to powder in HCl, then to filter the solution and add ammonia in excess, when if oxalate of lime was present he obtained a white precipitate. Continuing his experiments, he isolated oxalic acid, and later while experimenting upon sugar found that he obtained from that body by action of nitric acid a new substance, which he proved to be oxalic acid, and identical in composition with that which he obtained from the various plants.

When a few years ago Kolbe discovered that he could synthetically make salicylic acid, the world hailed the discovery with a glad shout ; but poor Scheele's discovery that oxalic acid could be made in the laboratory, although equal in importance to the German chemist's work, aroused very little enthusiasm.

His plan for the separation of the organic acids was to saturate the juice of the plant with chalk, and to decompose the resultant lime salt of the unknown acid with either muriatic or sulphuric acid. When the organic acid was soluble in water, he used H_2SO_4, thereby setting the acid free in solution, and producing an insoluble salt of lime, which was filtered off, and the acid solution set aside to crystallize.

When the acid was insoluble in water, as in the case of benzoic acid, he decomposed the lime salt with HCl, and in this way forming a very soluble salt of lime, and setting the acid free as a precipitate, which was separated by filtration.

Scheele was the first to introduce this method, which equals our most approved methods of to-day, for previous to that time the only way of preparing these acids, of which only a very few were known, was by sublimation.

In endeavoring to discover the causes which led to the souring of milk, he discovered lactic acid, and gave a method for its production upon the large scale, and while engaged upon this investigation found that he could prepare oxalic acid by action of HNO_3 on milk sugar.

He was the first to chemically examine the urine, and to discover uric acid, which he proved was always present ; and also pointed out the presence of benzoic acid in urine, and gave a method for the preparation of the same.

Phosphorus was first discovered by Brandt, who detected its presence in urine while endeavoring to extract from that liquid a substance capable of transmuting silver into gold ; and Dr. Gahn first pointed out that there existed in bones combined with lime an acid similar to that occurring in urine, and Scheele soon after proved this salt to be phosphate of lime, and gave a method for the extraction of the phosphorus.

Here, as elsewhere, Scheele figures as the practical chemist, who not only made discoveries, but put them to actual use ; yet much of the honor that should be his is given to others ; he suffered as scientific and literary men do to-day at the hands of pirates.

While Scheele was at Stockholm he sent to the Academy an elaborate account of his investigation of tartaric acid ; but no notice was taken of it, and, impatient of the delay, he rewrote the article, and gave it into the hands of Retzius, the clerk of the college, and in 1770 the paper was published in the Transactions of the Stockholm Academy, but in such a way that the whole credit was given to this Retzius. But nature takes care of her children's honor, and posterity crowns many a man whose life was blighted by just such causes.

Two of Scheele's important investigations in organic chemistry were in connection with glycerine and Prussian or Berlin blue, as it was then called.

Perhaps you think I lay too much importance upon such simples ; but you must remember that Scheele possessed no such advantages as the student of chemistry does to-day. An humble apothecary's clerk, working with poor apparatus, he has set an example that should stimulate all young men to attempt to follow where he led.

Glycerine was discovered by Scheele while heating oxide of lead with olive oil in the preparation of lead plaster. He recognized it to be a new body, closely studied its properties, found it could be obtained from various other oils and fatty bodies, and called it the "sweet principle of fats." This discovery, the real value of which Scheele never fully recognized, must be considered as one of his most important when we think to what an extent the manufacture of glycerine has grown.

His experiments with Prussian blue show his ability as a chemist, and illustrate one of the most interesting events of his life. Prussian blue was discovered by an accident about the year 1710. Dresbach, a manufacturer of colors in Berlin, wished to prepare a red lake, and borrowed from the chemist Dippel, who was the

discoverer of a peculiar oil which he obtained by the destructive distillation of animal matter, and which is known as "Dippel's oil" to-day, some alkali that the chemist used in the preparation of this oil; and when Dresbach added the alkali to his mixture of cochineal, alum, and green vitriol, he obtained a blue instead of the red color he sought. He mentioned this fact to Dippel, who soon succeeded in preparing this pigment at will, and which acquired a large sale under the name of Prussian blue. Dippel did not know the origin of this color, and though various chemists endeavored to explain it, its manufacture remained a secret until 1724, when Dr. Woodward published a formula for making it, and the celebrated chemist Macquer began an investigation to discover the source of the color, and after an elaborate series of experiments came to the following singular conclusion : "Prussian blue is nothing more than iron supersaturated with phlogiston." Now this body, phlogiston, with which we shall have soon to deal, seems to have played the part with the early chemists that malaria now does with the doctors : any fact a chemist could not explain was smoothed over by ascribing it to phlogiston—very much as many physicians nowadays cover up their defects of knowledge by classing whatever they cannot explain as malaria.

Scheele was the first to give a true explanation, which was published in the Transactions of the Stockholm Academy for 1782 and 1783. He observed that Prussian alkali after its exposure to the air lost its power of producing Prussian blue, and in order to discover what had become of it, placed a piece in a tightly corked glass globe and allowed it to remain for several days, when upon testing it he found that no change had occurred. Accordingly he conceived the idea that something present in the air caused the decomposition, and came to the conclusion that it was the fixed air (CO_2). To determine this, he filled a globe with this gas, and placed a small piece of the alkali at the bottom, and allowed it to remain closed for twenty-four hours. Upon examining the salt at the end of that time he found it had lost its property as before. He repeated this experiment, but attached to the cork a slip of paper, which had been first dipped in a solution of sulphate of iron and afterward in an alkaline solution to precipitate the iron. At the end of two hours he took out the cork, and moistened the slip with a drop of muriatic acid, and to his delight obtained a fine blue color. A modification of this test, known to-day as Scheele's test, is one of the most decisive we have for detecting hydrocyanic acid. Scheele next found that other acids would separate the coloring principle, as he then called it ; and not satisfied with this knowledge, he determined to discover its composition, and for this purpose boiled Prussian blue with oxide of mercury and water until the blue color disappeared ; then he filtered the solution, and added some iron filings and sulphuric acid, when the iron was completely dissolved and the mercury precipitated. To this solution, consisting of the coloring principle and sulphate of iron, he added some more sulphuric acid, and subjected the whole mixture to distillation, and obtained the coloring principle, as a thin, strongly smelling liquid, with the nature of which he was still unacquainted, which to further purify he redistilled over carbonate of lime. Still in the dark as to its origin, he sought further to find out its composition. To accomplish this he mixed some charcoal and potash in a crucible and kept the mixture at a red heat for some time ; then he added a small quantity of sal-ammoniac, and continued the heat until all odor of ammonia was gone ; when cold, he dissolved the salt in water, and obtained all the reactions of prussic acid, and from this concluded that it was a mixture of charcoal and ammonia, but from want of proper apparatus could not tell what proportions, and it remained for Berthollet to prove that, while it contained the same elements as charcoal and ammonia—that is, carbon, nitrogen, and hydrogen—they occurred in different proportions, and he showed the formula to be HCN. This example, which I have given at length to show how much Scheele was in advance of his time, exhibits his power of research in a striking degree, and calls forth both admiration and wonder. While Scheele's fame rests upon his many discoveries, it will be necessary, in order to more properly appreciate his work, to glance at the theories that existed prior to and during his day. Chemistry did not begin to assume its position as a science until the time of Becher, about the middle of the seventeenth century ; and it is only with the researches of Lavoisier, whose way Scheele prepared, that chemistry emerged from the mystery that had shrouded it. Prior to Becher, chemistry was in the hands of the alchemists, a body of men who, seeking rather to deceive than to instruct, endeavored to give the impression that they conversed with spirits, from whom they had learned the secret of how to indefinitely prolong life and the power of transmuting all baser metals into gold. With the advent of more scientific methods the power of the alchemists dwindled away. Becher was the first to outline a theory of combustion, which was afterward developed by his disciple Stahl into the phlogiston theory, which was universally accepted by scientific men throughout the world until it was finally overthrown by Lavoisier. To show how firmly this theory had taken root, I quote from a chemistry published in London in 1788,[*] two years after Scheele's death, the following statement : "A modern sect of French philosophers, called Antiphlogistians, have endeavored to blow up this first pillar of chemical theory, but in vain ; it stands upon the firm basis of demonstration, and it will stand forever." In this same volume the four physical elements are described with their appropriate symbols as fire, air, earth, water, yet the preface contains this remarkable statement : "From the preceding part of this preface it must appear that chemistry is an entire new science ; that all old books are useless, and that many of those of no very ancient date must be defective and erroneous."

In the year 1767 a series of experiments were instituted at the Paris Academy in order to prove that the elements were interchangeable, and more particularly that water could be converted into earth. You all no doubt remember the old story of how the earth that collected in the retort after repeated distillation was deemed conclusive evidence, until Scheele analyzed the deposit, and found it to consist of the same elements as

* First Lines of the Theory and Practice of Philosophical Chemistry. By John Berkenhout, M.D. London, 1788.

the glass, and suggested that it might be derived from that source, and Lavoisier, following his footsteps, with the aid of the balance proved that while the water did not change, the retort lost in weight, and the loss just equaled the amount of the deposit. Thus this theory was overthrown.

Scheele did not believe that because two pieces of ore were obtained in the same locality they must of necessity have the same composition. And in this connection I am reminded of an anecdote.

Fire in olden times was regarded as a certain elementary body capable of devouring all combustibles and converting them into itself. They said, if you bring a small quantity of this substance—fire—to a grate full of charcoal or other combustible, it immediately begins to devour it, and whatever part is unfit for food is left behind in the form of ashes.

Becher's theory of combustion explained that process by stating that all metals were composed of an earthy substance common to all, and a combustible principle also common to all, while they differed from one another by a peculiar mercurial element; and that when a metal was heated so that it changed its form, the mercurial and combustible elements left it, and nothing remained but metallic calx.

Stahl's theory, which is simply an enlargement of Becher's, taught that all combustibles contained a combustible principle known as phlogiston, to which their combustibility was due. This principle was the same in all bodies, which differed from one another on account of other substances which they contained. Combustion depended upon this substance, and when it left a body, the remainder was incombustible.

Mayow pointed out that metals when calcined increased in weight; and the followers of the phlogiston theory endeavored to explain this fact by stating that as phlogiston is in itself the cause of gravity, it would be absurd to suppose that it possessed that property, but rather to be endowed with the power of levity; and hence when phlogiston leaves a body it is not buoyed up as much as before, and consequently heavier. These ideas, crude as they seem, were a great stride toward the founding of a system by which events might be systematically studied.

In other sciences thought was not much further advanced. Linnæus, the great botanist, a countryman and contemporary of Scheele, in his "System of Nature," after outlining the formation of the earth, describes the ocean as follows:

"The water of the ocean, frigid, passive, concipient, everywhere fecundated by a dry, calescent, active generating air, is observed teeming with a double offspring—a saline male, soluble, acrid, clear, and crystalline; a terrene female, fixed, viscid, opaque, attractorial;" and describes the following substances as occurring in sea-water:

"Muria, which is marine, and which by corrosion attracts clay; natrum, which is animal, and which by refridation coagulates calx; niter, which is aerial, and which by obduction augments sand; alum, which is vegetable, and which by ramification cements soil." "These are the fathers of the stones."

Again he describes four kinds of earth: "Clay, the earth of marine water; sand, the earth of rain water; soil, the earth of vegetables; calx, the earth of animals;" and adds, "These are the mothers of the stones."

Now as Scheele lived in the latter part of the eighteenth century, during a time when the phlogiston theory was the accepted explanation of a great many phenomena, much of his writings bear the mark of this relic of ignorance, and show to what straits chemists were reduced in order to make facts agree with this, as it seems to us now, ridiculous theory; and this brings us to Scheele's most important discovery—that of oxygen, the honor of which he shares with Priestley; and although there seems to be some doubt as regards dates, yet, as Lowell says, "Biography now holds dates cheaper and facts dearer" than it formerly did; and although, as I say, there seems to be some doubt as regards the dates, yet the fact that each discovered oxygen independently of the other is beyond question, Priestley calling it "dephlogisticated air," and Scheele "empyreal air," each working with different substances. Priestley obtained his gas while heating red precipitate, and Scheele his by the same method from black oxide of manganese.

It will be interesting to state here, that about one hundred years before this discovery, Dr. Hooke pointed out that there existed in air a certain body similar if not identical to that contained in saltpeter, though he says there exists in saltpeter a much larger quantity than is contained in a given bulk of air. This body possesses the property of dissolving all combustibles, but only when the temperature is considerably raised; and Mayow ten years later advanced this same opinion without giving Dr. Hooke any credit, and called this body "spiritus nitro-aereus."

In a treatise upon air and fire, contributed to the Stockholm Academy, Scheele, after a vast number of experiments, conducted with great skill, proved that the atmosphere was composed of two elastic fluids: one of these he called "fire air" and the other "vitiated air." He proved their presence in many ways: one method was to absorb out the fire air; this he did by means of a solution of liver of sulphur or a mixture of iron filings and sulphur moistened with water. He found the relations of these gases always uniform, and recognized that fire air was the same as the gas obtained from heating saltpeter, or from KNO_3 or MnO_2.

This research is a masterpiece of work, but on account of the prevalent ideas he was led to wrong conclusions in regard to many of the phenomena. Had his life not been cut short at such an early age, he would, as was characteristic of him, have followed up his experiments until he obtained the truth. He was one of the first to doubt the phlogiston theory, but had no means of confirming his doubts. He says in the same essay, "I am disposed to believe that all acids owe their existence to fire air"—an opinion, although erroneous, which was shared by Lavoisier. Through lack of proper apparatus he was not able to attach the importance to the combination of H and O that it deserved. Scheele mixed H and O in a glass globe over water, and passed a spark through the mixture, when the gases united with a sharp report, and the water rose until it completely filled the jar. Heat was generated, or, as it was called then, caloric, and as this was considered a property of phlogiston, Scheele thought that by union of H and O caloric was produced; and it remained for Cavendish to prove, by conducting this experiment in dry vessels, that not only was heat produced, but a second and

more important result was obtained, which led to the discovery of the composition of water. Scheele pointed out the power light possessed of decomposing certain salts, and showed that the violet ray was the most active and the red the least, but supposed that the difference was owing to different quantities of phlogiston with which the rays were combined, the violet containing the most and the red the least.

Another important investigation of Scheele's was in connection with manganese, and while engaged upon this body he discovered chlorine and barium, and in the latter body recognized a reagent for H_2SO_4. Mayow had endeavored to prove that phlogiston was identical with H, and Sheele accepted this view, and called the gas he obtained by action of HCl on MnO_2 "dephlogisticated muriatic acid." He studied its qualities, but found it contained no O; yet many chemists believe that it was a compound of O, and called it oxygen muriacid, which was contracted afterward by Kirwan to oxy-muriatic acid, and finally changed to chlorine by Sir H. Davy, who proved that it contained no O, and confirmed the ideas of Scheele.

He discovered a new element in fluor-spar, and was the first to make HF, but was unable to obtain it pure, as it attacked the glass and dissolved the silica; and here again others with superior apparatus received the credit that should have been his. An anecdote in relation to alum will show how conversant he was with analytical methods. Baum supposed that when fluor-spar was melted with potash, and the mixture treated with H_2SO_4, that he could obtain alum. He accordingly mixed these two bodies, placed them in a crucible, and heated them, and after removing from the fire when the mixture had cooled, he treated the mass with H_2SO_4, and evaporated the solution, and obtained alum in crystals, which was deemed conclusive enough, until Scheele showed that the alum was derived from the crucible in which the experiment had been conducted. He discovered wolframic and molybdic acids, and proved the difference between molybdena and plumbago with which it had previously been confounded. He discovered the nature of plumbago, by finding that it was entirely consumed when thrown upon melting saltpeter; he also first gave the hint that afterward led to the discovery of the composition of steel.

His experiments with arsenic, whereby he discovered arsenic acid and arseniureted hydrogen, are very interesting; but there is so much work that I can but briefly outline it. Arseniureted hydrogen he discovered accidentally, yet with his accustomed ability followed up the discovery until he had learned all he could about it; he found that it was combustible, and deposited arsenicum when burnt. It is to this important discovery that the so-called Marsh's test, which should be called Scheele's test, depends. He was not only aware that he could generate the gas from metal and an acid to which he had added some arsenic, but also that all metals contaminated with arsenic gave the same results.

He contributed very much to the knowledge of ether, and made a great many organic ethers, which have no other value than to illustrate the range of his experiments, among which there may be mentioned oxalic, citric, tartaric, and benzoic ether. He also proposed the method for making acetic ether which is in use to-day.

He proved the similarity between calomel prepared by sublimation and that by precipitation, and was one of the first to early study and describe the properties of albumen.

Scheele lived a quiet, peaceful life, happy in his work, and to within a year of his death was simply an assistant. In 1775 he went from Upsala to Kopping, to take charge of a pharmacy, the proprietor of which had recently died; and there he seems to have conducted the business so well that he won the good graces of the widow, and married her two years later; here he remained until his death, which occurred in 1786.

When we look back at the amount of work Scheele contrived to do while attending to his regular duties, we ask ourselves with wonder how he found time for all this; yet he is but another example of the earnest worker, who, without education or means, but by perseverance and energy, "finds a way, or makes one."

This paper is offered as a tribute to the memory of a man who, while his name will always be connected with the most brilliant chemical discoveries, will also be known as the "Gothenburg Apothecary," and the writer hopes that some one with more ability than he possesses will follow these footsteps, and show us more of this genius, and stimulate young pharmacists of to-day, by showing what may be done under obstacles. Poor, unaided, without station, Scheele won for himself a very dear place in the hearts of all men of science; and it is eminently proper that we honor him now, inasmuch as he received so little during his life.

All the sciences owe much to pharmacy, and it in turn is deeply indebted to them; yet if every college where chemistry is taught would endow one free scholarship to any struggling pharmacist who chose to take advantage of the opportunity, it would be no more than is due to the memory of this Swedish apothecary, Carl Wilhelm Scheele.—*Pharmaceutical Record.*

## THE RECENT EARTHQUAKES IN FRANCE.

THE southeastern part of France has recently been the seat of some quite violent shocks. The first tremors noticed date back to Sunday, November 23. Between three and four o'clock in the afternoon a vibration, which fortunately lasted but two seconds, was felt at different points of the Brianconnais, Queyras, and Embrunais. On the following days a few movements of the earth were noticed, but the most powerful oscillations manifested themselves on the 27th of November, at eleven o'clock at night. These followed the general direction of the valley of the Durance, and extended from Aiguilles and Queyras as far as to Marseilles. The last waves of this vast movement were perceived at Grenoble on the one hand, and at Toulon and Cannes on the other. According to information gathered upon the spot, the shocks kept increasing from the Mediterranean coast to the Italian frontier, and, for the same place, were more intense at the bottom of the valley than at the top of the mountain. Thus, in the district of Briancon, for example, the earthquake was more violent upon the banks of the Guisanne and Durance than near the neighboring crests. The famous Fort Infernet, which is perched at a height of 8,000 feet, was not spared, it is true, but the structures were less dam-

aged there than at Sainte Catherine, whose altitude does not reach 4,200 feet. Here the effects of the shock, on the night of the 27th, were quite serious. The extent of the oscillations was sufficient to throw to the ground a clock that was placed a few inches from the external edge of its support, and the walls of the houses were everywhere cracked and the ceilings fissured or put out of shape.

The roof of a cottage at Sainte Catherine was suddenly converted into a vibrating plate, and was destroyed in several places equidistant from each other. The holes made therein (shown in Fig. 1) cannot be attributed to the fall of bricks from the chimneys. The slates were pulled off, and not broken, and the portions of the framework left bare, far from being on a line with the chimneys, were at nearly equal distances between them. Moreover, the end chimneys did not lose a single brick, and yet the roofing was as badly damaged at these two points as it was elsewhere.

A certain number of chimneys, thrust at the base with some force, were broken off in the direction of their line of contact with the roof, and moved an inch or more in a straight line, in consequence of the suddenness of the shock (Fig. 2). Others, obeying a rotary motion, took a new position (Fig. 3). Certain capstones, weighing from 660 to 680 pounds, obedient to the laws of inertia, did not partake of the general motion, but remained in unstable equilibrium at the top of the chimneys. One of them broke through the roof near the ridge (Figs. 1 and 4).

These phenomena occurred in structures lying paral-
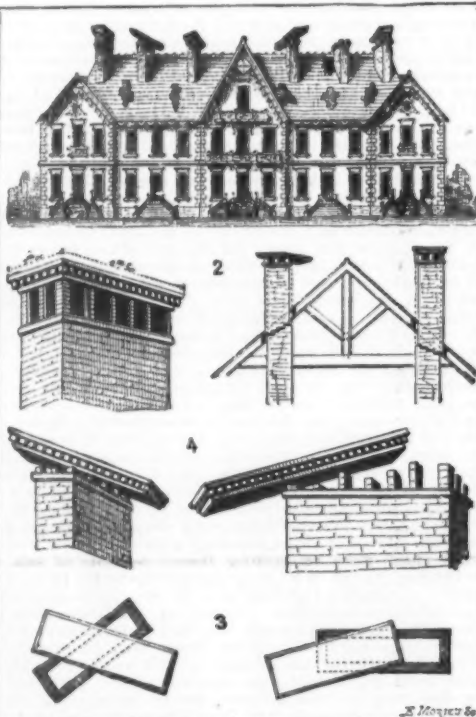
EFFECT OF AN EARTHQUAKE UPON A COTTAGE AT SAINTE CATHERINE.

lel with the valley of the Durance. Houses standing diagonally thereto resisted the earthquake better in most cases. This remark tends to establish the fact that the most powerful undulations must have followed the general direction of the said valley.—*La Nature.*

PRACTICAL STUDIES IN GEOLOGY.*

CHAS. H. STERNBERG.

GEOLOGY is a world study, and takes the earth as soon as it was cool enough to allow the atmosphere to disgorge its contents on the steaming earth.

Then began the operation of natural laws, and the causes and effects, as we see them to-day. The rain fell in torrents on the steaming earth, and washed away the solid rocks, and in shape of clay or sand the streams carried it to lower levels and deposited it on the bottom of the sea, as sedimentary rocks. The study of geology is the grandest of the natural sciences, not only because it takes into consideration the largest object with which we have to do, but it includes vast lapses of time, so long in fact that if it does not prove that time is eternal, it shows at least that it is very old. The text-books of the geological student are the solid rocks in which the Creator has written in never fading characters the history of each succeeding period, its life, climate, depth of sea, etc. All the natural sciences bring from their storehouses things new and old to increase its interest. If we go to the seashore, and notice the shells lying on the beach which an incoming wave covers with sand or mud, we see the process by which fossils are made. The sea may come in and by pressure convert the sand or mud into solid rock, and the shells will be indefinitely preserved, and they represent existing species.

If we notice the accumulations at the mouths of great rivers, like the Mississippi, we find, mingled with the sand or mud trunks of trees, bones of animals, etc., that have been drifted from the far interior, a thousand miles perhaps. These are mingled with shells and seaweed from the seashore, and represent the life of a continent. The sand and mud may, by pressure, be converted into rock, and the relics be preserved for ages. Petrifaction will take place. This is a slow process; as the contents of the organic cells decay they are carried away by water, which holds silica in solution; this is deposited in the empty cells, making a perfect cast, and so cell after cell is built up of silica. This as I said is a very slow process. In Pliocene time the bones are but partially petrified, while only in the older forma-

*Read before the Kansas Academy of Science, November, 1884.—*Kansas City Review.*

tions are they completely silicified. Another way nature has of preserving her records is by making casts of shells, leaves, seaweeds, etc.; a leaf falling in the soft mud is covered up, and a perfect cast made of both sides. In some formations the lime of shells has been entirely carried off, and only casts remain. If we go to Florida, we will see the process of rock making. Shells are mingled with the remains of others that the waves have ground to powder, which acts as a cement binding the shells together, strong enough to use for building material.

If we go into the hills and find in the solid limestone shells, seaweeds, etc., we can but acknowledge that they represent the life of the period, when as soft mud this limestone was lying in the bottom of the ocean. And so by natural causes have all the geological records been kept. Many people suppose that the study of geology is dry and stupid, of old bones and rocks. But there is no wider field for the imagination than to people the old seas and lands with animals restored from their buried relics, to clothe the ancient lands with verdure, and map out the continents, study their physical geography, the depth of the sea, climate, and above all to study the introduction and succession of life on the globe and other manifold changes brought about in the animal creation, their development from lowly forms, and their progression through successive changes until the present state of perfection has been brought about. Life is too short to study the changes brought about by the lapse of countless ages. Mountains have been elevated, valleys hewn out, chasms drilled through the hearts of mountains, and many other grand phenomena. The early geologists divided the world's history into distinct periods, supposing that at stated times whole genera were swept from the face of the earth, and new ones created.

These periods have been divided into *Palæozoic* or ancient life, *Mesozoic* or middle life, and *Cenozoic* or recent life. The first period in *Palæozoic* time is the *Silurian* or age of mollusks, and the enormous belts of limestone laid down attest to the abundant shell-life of the period. This was followed by the *Devonian* or age of fishes. They were all cartilaginous, and but few of their remains are preserved; the *Lepidosteus*, resembling our common gar-pike, then appeared, as well as sharks and rays. The last period in *Palæozoic* time is the carboniferous or age of coal plants. The air was dense with carbonic acid, and the luxuriant plant-life cleared the air of this poisonous gas, and stored it away in the great coal fields. Among the plants were the *Sigillaria*, *Tree Fern*, *Horse-tail*, *Cycads*, etc. The ground, and fallen wood, was covered with sponge-moss. At times the sea came in and covered the organic mass with sand or mud. The rulers of the estuaries were great placoderms. They were clad in armor of bony plates, resembling shields and bucklers. Sharks and rays, with huge frog-like batrachians, were abundant. At the close of *Palæozoic* time, *Cenozoic*, the age of reptiles, began. The first period is called Jurassic, from the Jura Mountains. Here both on land and sea enormous reptiles reigned supreme, and America has furnished some world-renowned monsters. In the Rocky Mountains, for a number of years, large bones have been found. People supposed them to be fragments of fossil wood.

In 1877 Professors Marsh and Cope made important discoveries, and published the results of their labors, thus adding another chapter to American palæontology. These were the largest known land animals, and are called dinosaurs. The larger ones reached a height of twenty-five feet and sixty feet in length. They were plant eaters, and fed on the leaves and tender branches of the luxuriant forests through which they wandered. The carnivores, or flesh-eaters, were smaller and more elegantly built for springing on the clumsy herbivores. They had on each jaw a single row of recurved, serrated teeth. The plant-eaters had several rows. In the Judith River group the *dinosaurs* walked erect; their front limbs were small, and armed with claws for grasping the branches of trees on which they fed. A ponderous tail helped to support their enormous weight. They had three rows of teeth in each jaw, with a magazine below each old tooth, containing five young ones. As fast as one row wore off another took its place. We found thousands of these cast-off crowns. The second period is called the Triassic. Here huge reptiles on sea and land were the ruling types. Some are called labyrinthodonts, from the peculiar manner in which the enamel of the teeth is folded. They were clad in armors of bony plates. Crocodile-like animals, with beautifully sculptured bones, were common, as well as sharks, gars, etc.

In northern Texas the beds are made up chiefly of red clay, which is so finely divided that all the waters flowing from them, hold it in solution. During high water or on windy days, the water is as thick as cream. The next period is the Cretaceous, when the chalk of England and America was laid down. The first group in the west is called Dakota, by Prof. Hayden. The formation of red sandstone and variegated clays were laid down in an open sea dotted here and there with islands. The formation enters Kansas near the mouth of Cow Creek, extending in a northeasterly direction through the State, Nebraska, Minnesota, British America, and so on to Greenland. The trees, like those in our existing forests, then appeared. Here flourished the magnificent red-wood, *Catalpa Menispermites*, tulip-tree, cinnamon, fig, *Sassafras*, etc. They left impressions in the sandstone of Kansas and Nebraska, and some two hundred species have been described by the noted palæontologist Prof. E. Lesquereux, of Columbus, Ohio.

During the Niobrara group great beds of chalk and blue shale were laid down in western Kansas. Here appeared the first bony and edible fishes; *Portheus Molossus*, Cope, reached a length of twenty feet. It had a large bulldog-shaped head with fangs projecting four inches from the mouth. It had another weapon of offense and defense in the shape of pectoral and dorsal fins, three feet long. In some species, one edge is serrated, and even in their fossil form are hard enough to be used for splitting wood. Another peculiar species was Cope's *Erysicthes*, or snout-fish. It used this weapon as a modern sword-fish does its sword. But the rulers of the deep open sea were the saurians, or sea-serpents. Cope's *Liodon poriges* reached a length of eighty feet. It had four powerful paddies, which by the aid of a long, eel-like tail enabled it to go through the water at great speed. Its weapon of offense was a long bony snout, that was used as a battering-ram.

Clidastes tortor, Cope, was a small animal, about forty feet in length. It was provided with an additional set of articulations in the vertebræ to enable it to coil up, like a snake. Marsh's *Clidastes pumulus* was only twelve feet long, and doubtless often fell a victim to the sharks and other rapacious fishes that abounded in these waters. One peculiarity of these saurians was that they had no expansible gullet, as in modern serpents; another method was given them in the shape of hinges of the ball and socket pattern just back of the dentry-bone. This enabled them to expand the cavity of the mouth and swallow large morsels through a pelican-like throat.

The most interesting fossils found in the rich beds of western Kansas are Marsh's toothed birds. His *Hesperornis regalis* reached a height of nearly six feet. The wings were not developed. They were swimmers, and lived on fishes. They were provided with a row in each jaw of sharp, reptile-like teeth, and thus nearly approach them. Many suppose that they were derived from reptiles; another proof is in the oldest of all birds, that had a long vertebrate tail; and the most important discovery in this line was made by Prof. Marsh this year in the Rocky Mountains, having found a small dinosaur that walked. The metatarsals and carpals were united, as in all modern birds.

Great flying dragons, or *pterodactyls*, were common, with stretch of wings of twenty-five feet. They were toothless, and Marsh has made the new genus *Pteranodont* for them. Another very unique species was Cope's *Protostego gigas*. It measured twenty feet from one flipper to the other, and instead of the ribs being expanded and united, as in modern turtles to form a shell, they were separate. Instead of a shell, they were provided with great dermal plates, an inch thick in the center, two feet in diameter, and beveled off to a thin figured margin. One specimen found by my party in 1877 weighed 300 pounds after the matrix was removed. It was eighteen inches from one condyle of the lower jaw to the other. Great oyster-like shells, twenty-seven inches in diameter, were found. But we must leave this interesting group to go on to Cenozoic time, the age of mammals, which is divided into three periods—Eocene, or early dawn; Miocene, or middle dawn; and Pliocene, or recent dawn of the existing state of things. Great mammals roamed through the dense forests of the Rocky Mountain region, which was a level, swampy country. The temperature was tropical, and plant-life luxuriant. Here we find ample material for the study of the ancestors of modern animals. The horse had many ancestors, and their remains have been eagerly sought for. In early Eocene time he appeared no larger than a fox, with five toes on the hind feet. The folds of the tooth enamel were simple; later on he had discarded his two side toes and walked on three, later still only one toe on each foot was in functional use. The side toes were like the dew claws of a dog. The enamel was complicated and resembled that of the recent horse, that has only the rudiments of these side toes in the splint bones; and so the ancestors of other animals have been traced. The camel has two toes, and the two metatarsals and carpals are united, a medullary canal extending the whole length of the bone on each side. I was so fortunate as to find a camel in the Miocene of Oregon that had the two metatarsals and carpals entirely distinct. In the Loup Fork Pliocene I have been employed the present season, for the U. S. Geological Survey, and have been remarkably successful.

My party have procured 15,000 pounds of fossil vertebrates. They consist chiefly of three species of rhinoceros, the mastodon, camel, horse, a small deer, lion, etc., all from one locality. Great numbers of bones have been washed from some river into a deep hole, in the lake, and everything in connection with them proves that the place of death was but a short distance from that of burial. The bones were scattered through sand on a bed of calcareous sandstone. Rhinoceros bones were the most abundant; Cope calls them aphelops. They were without horns, and had large sharp canines in the lower jaw, and also in the premaxilla. These were oblong in shape and ground against the lower ones, keeping them always sharp.

In some cases the premaxilla was several inches longer than the nasals, and had doubtless a flexible trunk. They had three toes on each foot, and were about the size of existing species. These beasts lived alone in herds; no other animal, no matter how fierce, would care to attack or associate with them, for in addition to their sharp tusks, their skin was thick and folded. The bones were indiscriminately mixed. It was not uncommon to find camel vertebræ between the branches of the lower jaws. We found several skulls with lower jaws attached and one perfect front foot. All the others were scattered, except the tibia and fibula that were anchylosed together.

A large mastodon lived at this time, with inferior tusks. In 1881 I discovered a perfect lower jaw, that measured five and a half feet from the point of the tusk to the angle of the jaw; the jaw was four feet long. This season I procured four upper teeth together in fragments of the maxilla. The largest was seven and a half inches long and three inches wide. Turtles were also common; in 1881 I procured twenty specimens from a narrow gulch. Some of the shells were beautifully sculptured. They were all land and fresh water turtles. But time will not allow me to go more into details. If I have been so fortunate as to interest some of you enough to go more deeply into the subject than I have to-day, I shall be most happy.

SALT IN NEVADA.

THE largest deposits of salt on the Pacific Coast are found in Nevada, where they occur under various conditions. The most extensive and remarkable of these deposits is that on the Rio Virgen, a few miles north of the Colorado river, in the extreme southwestern corner of the State. A formation exists at this point composed of rock salt, resting on, and to some extent intermixed with, a sedimentary granite, and of such magnitude that it may be said to constitute a notable portion of the mountain in which it occurs. More than 60 per cent. of the entire mass appears to consist of hard rock salt, having the color and transparency of clear ice, and containing over 90 per cent. of the chloride of sodium. This formation extends along the eastern bank of the Virgen, presenting a bluff face to the stream for a distance of over twenty-five miles, and is in some places several hundred feet thick.

This deposit is worked after the manner of an open quarry, the salt being removed in blocks weighing often many pounds each. Although blasting is sometimes necessary in breaking it out, large quantities of quite pure salt can be obtained here at very little cost. Some twenty miles up the river is another hill of salt. In the same neighborhood, at a point one mile north of the Colorado river, on a mesa composed of small pebbles, earth and bowlders, occurs a circular opening about 100 feet across, and of great depth, forming a sort of natural well, with nearly vertical sides. This is filled to within about 50 feet of the top with water, supersaturated with salt, this pool being apparently all that is left of the "dead sea" which once covered the entire region. These salt beds are in an isolated locality.

The other more notable salines of Nevada consist of salt springs on the line of the C. P. R. R., near White Plains, Churchill county, where there are large vats for making salt by solar evaporation. These vats are shallow excavations, inclosed with low embankments, with which the brine is run, being lifted with pumps from some of the springs. Most of the mills in Virginia City and throughout western Nevada are supplied with salt from this source.

As it fairly represents a large class of these deposits, a description of the general features of this Sand Springs saline will serve to convey a pretty good idea of the whole. The saliniferous land at this place occupies a depressed portion of an extensive alkali flat, this depression being always marshy, and, during the wet season, covered with a few inches of water. Spread over it is an incrustation of impure salt from two or three inches in thickness, brought up by efflorescence from below. In collecting the salt this crust is broken up and scraped into heaps with broad wooden hoes, the ground being divided into long strips, which are gone over in regular order. These heaps, after being left to drain off for a few days, are carried out on wheelbarrows or cars and thrown on platforms, where, after undergoing some further drying, the salt is sacked and is ready for shipment. As soon as this surface incrustation has been stripped off, it begins to re-form, the process going on so rapidly that several crops can be gathered yearly. As the ground below is heavily charged with salt, the process of replacement, were the surface removed, would no doubt go on indefinitely. The salt collected here, though not very clean, being mixed with a small percentage of sand, soda, and other impurities, answers well for metallurgical purposes, the alkali present tending to clean the quicksilver and intensify its action. A large portion of the alkali flat outside of this depression is covered during the dry season with a thin coating of salt, generally too high and too much filled with foreign matters to be gathered.

The Great Salt valley is forty miles north of Sand Springs. Under the top incrustation here comes a stratum of blue clay eighteen inches thick, and then a lead of crystallized salt.

In the easterly part of Esmeralda county, and having the town of Columbus as a center, is a series of immense alkali flats, containing heavy deposits of salt. At Rhodes Marsh, one of these groups, hundreds of acres are underlaid by a hardpan of solid salt, more or less mixed with mud and sand. Into these, holes something like tanners' vats are dug and soon fill with water holding salt in solution. The water evaporating, in five or six weeks the salt is left. At Silver Park, forty miles southeast of Columbus, incrustations of salt cover several hundred acres. There is also a marsh twenty miles south of the old overland stage road, near the Utah line, and 175 miles west of Salt Lake. In early summer the marsh is covered several feet with water from melted snow. Late in the season, when the water evaporates, a crust of salt, from two to eight inches thick, is left. Mills in that part of the State are supplied from this marsh. In Big Smoky valley, Lander county, and in Cortez District, sixty miles further south, large areas of ground are found covered with a thin crust of salt. In fact, workable deposits of salt occur all over the State of Nevada. The active season of work at most of the deposits is from April to December. There are some $75,000 or $100,000 invested in the salt business in that State. Indians and Chinamen as well as white men are employed.—*Mining and Scientific Press.*

ON THE SECULAR DECREASE OF THE EARTH'S MEAN TEMPERATURE.[*]

By G. D. HISCOX.

THE question of the decrease of the mean annual temperature of the earth having been alluded to at our November meeting in the discussion upon Professor Coakley's paper on the "Absorption of the Water and Atmosphere of the Moon," I have thought it well to bring before you a few points in its geological aspect; as well also, the possibility of a secular movement or gyration of the earth's polar axis as factors; the one as a constant, the other possibly a recurring variable in a great cycle.

In the geological descriptions of the polar regions, not only are the stratification of the Azoic, Silurian, Devonian, Carboniferous, and reptilian ages found with their fossil imprints of fish and reptile, but even to the Post-tertiary with its lignites and recent shells, reaching by upheaval a height of a thousand feet above the sea, as at Cornwallis and Beechy islands, the imprints of the saurians of the Tertiary age making a well marked point in the Arctic exhibit.

The fossils of the Silurian and Devonian ages pass through their gradations as in lower latitudes, while the development of the flora of the Carboniferous period, as represented in the coal beds of Melville and Byam Martins islands, and also along the border of the Arctic sea, are types of the coal bearing strata of mid latitudes; representing as they do the gradations from the true Carboniferous era through the lignite period with its petrified trees of a growth and kind now only known to warmer latitudes.

These facts give strong evidence of the existence of a tropical climate, gradually merging into a lower temperature near the present polar axis during these long periods. Nor does this strange series end here. The immense peat bogs with their buried trees, found in high latitudes, together with the remains of the mastodon found under the perpetual snow of the Arctic shore, seem to complete the chain of local events showing the beginning of life on the earth at the poles under the highest temperature compatible with existence, both vegetable and animal, while yet the equatorial region was a caldron of evaporative energy from the combined internal heat of the earth and the intense radiation of the sun in its primitive activity.

To further illustrate this theory, there seems, upon examination of the geological stratification of the whole globe, as far as known, a disposition to show a zonal division of climatic effect. The fossil and carboniferous deposits seem to indicate a time progress from the poles toward the equator.

The geological exhibit of the carbonaceous deposit in the torrid zone is so marked in deficiency, and as belonging almost exclusively to the Tertiary and later periods, consisting only of thin lignite seams in scattered localities, while the Silurian and Devonian deposits are but partially developed, or are entirely absent over vast areas, leaving the Tertiary resting upon the Azoic beds. The theory of the effect of the decreasing power of the sun's radiation upon the progressive climate of the various zones of the globe should be strengthened by the results of an examination and comparison of the geology of the globe by zones. The gradations of the stratified series from the Azoic, through the Palæozoic, Mesozoic, and Cenozoic ages, should show a zonic configuration, allowance of course being made for the interruption of any of the series by shrinkage, folding, and abrasion.

There is an advancing reason in geological inquiry favoring the theory of a *succession* of similar strata in different zones of the earth, and that their types are selective as to conditions inducing their formation rather than as to a successive time order. By this we may understand that the Azoic age of the Arctic region may have been coeval with the pre-Azoic at the equator, while the Tertiary age at the poles may have been coincident with the Devonian at the equator, as now the ice-bound Arctic is coincident with the tropics.

The recent extension of the era of the Azoic age, by the interpolation of several subdivisions making the beginning of organic life coincident with the dawn of the new Eozoic age, and the epoch of the fire crust an equivalent of an Archæan age, thus covering the later local subdivisions of the Keweenian, Taconian, Montalban, Arvonian, Norian, and Laurentian rocks by two grand divisions, seems to have lengthened our ideal of the period of development of the earth's history, and added further evidence of a uniform decrease in its mean annual temperature.

One of the pending problems of astronomy having a bearing upon this subject was mentioned by Professor Young in his address before the American Association, "The Constancy of our Polar Axis," and is receiving much attention in science circles in Europe. If the small amount of variation—one second in a hundred years—should be proved true at Pulkowa, and the denial of any change, as made at Greenwich upon observations covering 47 years, should also prove true, it is possible that the north polar axis may be moving at right angles to the Greenwich meridian toward central North America, thus placing the maximum of decrease of latitude in central Siberia, and the maximum of increase in central North America. This should affect the latitude of all the observatories in the United States—there being several whose records cover a series of years sufficient to prove or disprove this claim, the only doubt seeming to arise from the comparatively imperfect methods and instrumental adjustments by which this minute quantity has been overlooked.

I am informed by a prominent observer that there are but two observatories in the United States, the records of which are worthy of consideration previous to the last ten years, for developing so minute an anomaly as one or two seconds in a hundred years. This may amount to three seconds in a hundred years in our Western States, where there are no observations as yet to meet the case. Thus, we may readily see that one second on a radius between Greenwich and Pulkowa would be three seconds on the central meridian of the United States in a hundred years; surely some of our observatories should be able to detect this anomaly upon a few years' retrospect of their records, and define its amount and direction in the next ten years. If the displacement should prove only a gyratory orbit of small dimensions, its effect upon the geological and climatic progression will be scarcely perceptible; should it be found progressive in some great circle, its influence in causing geological contortions of the earth's surface has no doubt been great, but of slow progress, and in periods of long duration.

When we look at the amount of the spheroidal irregularity of the earth's figure, a depression at the poles of 13 miles, and in middle latitudes of above 6 miles below the equatorial diameter, we can readily conceive the effect of a gradual displacement of position of the axis of rotation—the gradual change of the level of the sea until the increased gravitation of some apparently lifted zone of the solid crust shall overcome its tenacity, when a cataclysm of equilibrium took place, such as we see so fully illustrated in the faults and upheavals of our geological strata, showing, as they do, evidences of former marine submersion to many thousand feet above the present level of the sea, together with an equal submergence of the flora of a former land.

Piazzi Smith, the hero of the science of the Pyramids, has taken an inspiration from this discovery as being an evidence of his views of the astronomical bearings of the pyramidal lines, or passages, at some thousands of years hence. His measure is 5 minutes in azimuth, and his computed time 4,000 years; so that if the pyramidal passages were coincident with the polar axis 4,000 years ago, it becomes a question whether the earth's axis has changed so much, or the pyramids themselves have partaken of a change through the geological contortions of the earth's crust. Probably the errors of observation 4,000 years ago may equalize the discrepancy, and after all the points bearing upon this controversy are considered, the astronomy of the Egyptians may have been more accurate than heretofore credited.
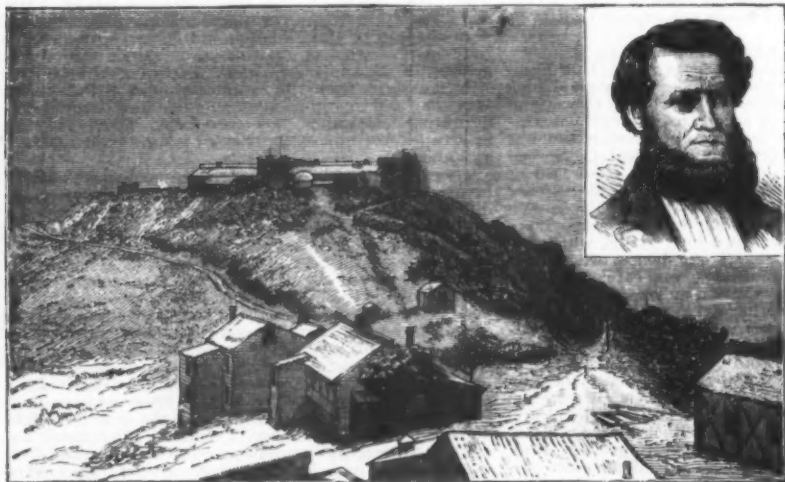
Following up the idea that the earth's axis may be shifting at the rate of 3 seconds in a hundred years at 90 degrees east and west from Greenwich, it will make a change in latitude of one minute in 2,000 years; one degree in 120,000 years; 10 degrees in 1,200,000 years; and 30 degrees in 3,600,000 years: numbers not inconsistent with the eras of geological time. With an entirely sub-
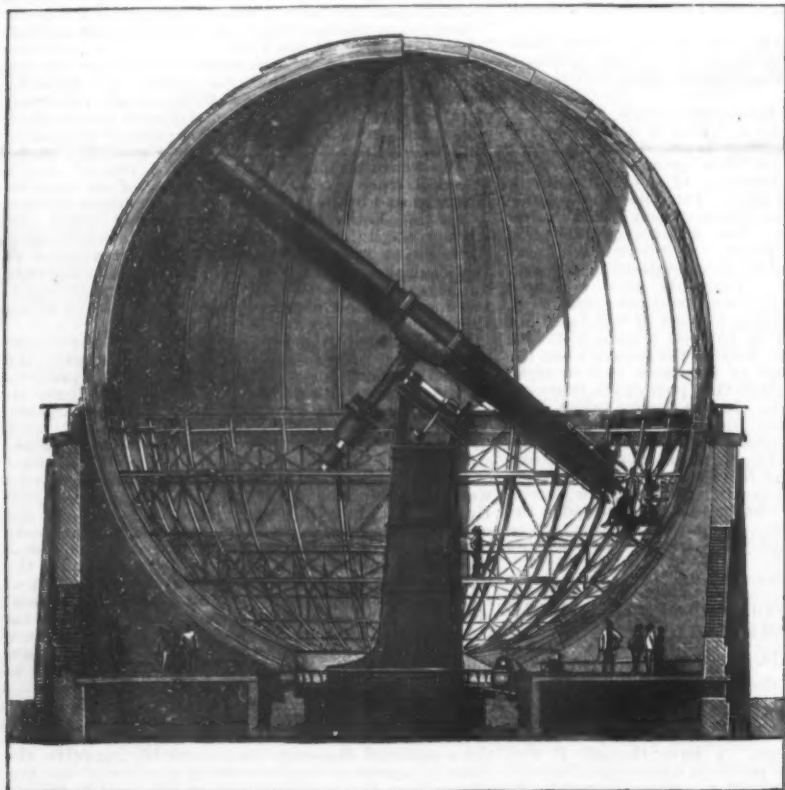
merged equatorial region closing the Tertiary age, the vastly increased evaporation from a great tropical sea, and the consequent precipitation of a constant cloud stratum upon the polar regions, together with our polar axis gyrating in an orbit sweeping over part of North America, near our magnetic pole, and so on through Northern Europe, would, we think, produce a geological era not incompatible with our conception of the great glacial period in its North American boundaries. There is as yet no evidence that the glacial periods of Europe and America were simultaneous; they may have been successive, for the evidence of their existence and boundaries mostly consists of rock scratches and bowlder drifts in both the Northern and the Southern hemisphere. Thus a change of 20 degrees in the direction of the polar axis in latitude from its present position toward our North American magnetic pole, together with the increased evaporation from over submerged equatorial continents, would doubtless carry the ice-bound region to the fortieth parallel, covering the higher lands of eastern North America with a vast

The floral indications of a decrease in the mean annual temperature of the earth within the historical age are so slight, that any attempt to establish even one degree would be futile, although the possible variations of the relative areas of land and water, or of the elevation and depression of surface, causing interior lakes and seas to disappear, may have had influence upon local climates. The evidence of such changes is found to exist in nearly all the continents. It will be perceived that with the moderate allowance of only one-tenth of a degree decrease in the mean annual temperature in 10,000 years, it will only be 10 degrees in a million years, and 30 degrees in 3 million years. This as a secular decrease alone would indicate at that remote period a mean annual temperature at the tropics of 120 degrees —a thoroughly tropical temperature for the middle latitudes, or coal-bearing zone, and a temperate climate in the polar regions. If this could be made to correspond with the Carboniferous era, it can be reasonably shown that a mean temperature of 120 degrees was a bar to the existence of a flora consistent with a carbonaceous

THE LICK OBSERVATORY, MOUNT HAMILTON, CALIFORNIA.

JAMES LICK was born in Pennsylvania in 1798, and was by trade a cabinet-maker. He led a roving life in his younger days, and passed much of his time in South America, where he accumulated a fortune of some thousands of dollars. With this sum at command he found himself in 1827 in San Francisco, then a sleepy little Hispano-Mexican settlement. Although the discovery of gold in California did not take place till twenty years later, Lick's shrewd vision foresaw the unrivaled capabilities of that splendid harbor, and he accordingly invested his money in the purchase of land. The result was that when the gold fields attracted an influx of population from all parts of the world, Mr. Lick speedily found his thousands of dollars multiplying into millions. Latterly he lived near San José, in the Santa Clara Valley. He was a man of very secluded and somewhat eccentric habits, owing, it was surmised, to some early disappointment in love; but little has ever

JAMES LICK.

LICK OBSERVATORY IN THE FIRST OCTOBER SNOW.

MOUNT HAMILTON, AS SEEN FROM A POINT 500 FEET BELOW ITS SUMMIT.

NEW SYSTEM OF DOME PROPOSED FOR THE OBSERVATORY BY T. E. FRASER.
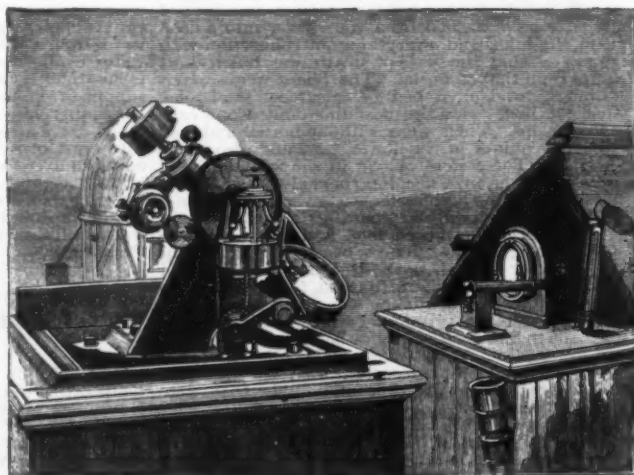
THE PHOTO-HELIOSTAT USED IN PHOTOGRAPHIC TRANSITS.

THE LICK OBSERVATORY, MOUNT HAMILTON, CALIFORNIA.

glacier, without necessarily interrupting the gradual decline of the earth's mean temperature.

To again refer to time, considered in the progress of the geological ages, as relating to the earth's axial displacement, 20 degrees would represent two and a half million years, and five million years a possibility for an entire circuit of its orbit. There appears in the geological succession of the stratified beds of the earth's surface a modification of several grand divisions that have been a mystery to geologists; a seeming upheaval or depression that produced an almost total extermination of existing life and a reappearance or birth of new forms and advancing types in the next series. We can recognize at least seven of these grand divisions that show evidence of cataclysmic action; then, if I am allowed to imply the computation of our fancied orbit of axial displacement, we have the modest number of 35 millions of years, since the crust of the earth began its plication. Even this may be far too small an assumption when compared with the scale of eternal time.

deposit in the equatorial region until a vastly later geological period, when the great coal deposit of middle latitudes had so thinned out the source of supply that the tropical growth at best could only bear a lignite crop—thus preparing the atmosphere, by balancing its component gases, for the support of *animated life above the waters* of the earth, marking the hour of a new creation upon the dial of eternal ages.

May we opine, as the time-marks of the long ages of the past prove the uncertainty of stability and the certainty of its own unwearied progress, that the Arctic zones will steadily encroach upon the now temperate regions of the earth with its impenetrable and enduring snows; while the temperate zones will move upon the tropics, to be followed by a relentless Arctic winter, and at last life become extinct upon the line of the equator, when solitude shall reign supreme?

DURING the past year ten new asteroids were discovered, making the total number known 245.

been discovered concerning the story of his early days. He was a skillful mechanic and diligent student, being especially fond of astronomy, and he made a resolution that the United States should possess the most powerful telescope in the world. For this purpose he made over by deed during his lifetime to a body of trustees the sum of 700,000 dollars, for the purpose of constructing the telescope in question, and housing it in a suitable observatory. The spot ultimately chosen was Mount Hamilton, not far from San Jose. It is 4,400 feet high, and the observatory stands about 150 feet below the summit. Mr. Lick bequeathed the bulk of the residue of his colossal fortune for charitable purposes, but that need not be here described. He died October 1, 1876, aged seventy-eight.

The building of the observatory was considerably delayed by law suits brought by Mr. Lick's kinsfolk, but eventually these obstacles were surmounted, and the foundation stone was laid June 30, 1883. Since then the work has advanced rapidly, and all but the large dome is now nearing completion.

The north dome is already completed, and has a very light and graceful appearance, as its beautiful curves are not marred by massive ironwork or ugly bracings. Captain Floyd and Mr. Fraser, though hitherto unaccustomed to this kind of work, have shown wonderful skill in its construction. It is of tin inside and nickel outside. The plates are fastened by overlapping joints, and there is scarcely a nail in the whole structure. It is easily turned by an endless wire rope worked by a crank. The chief instrument in the dome is the superb twelve-inch equatorial telescope, constructed by Alvan Clark, of Cambridgeport, Massachusetts. It is fitted with the best modern appliances.

To the rear of the Observatory proper is the Transit House, the Heliostat, and the Photographic House. In photographing the heavenly bodies, the sun is reflected from the surface of a mirror into a powerful objective glass of forty feet focus, which imprints the picture upon the sensitive plate in the Photographic House.—Our engravings are from photographs by the Rev. G. W. James, of Tuscarora, Nevada; and the foregoing details are condensed from a very full account by him, which exigencies of space prevent our using in its unabridged form.—*London Graphic.*

ON POTATO DISEASES.

WET ROT (Nassfaule) has been known as a tuber-destroying agency for a great number of years, long before the phytophthora appeared in Europe. Mr.
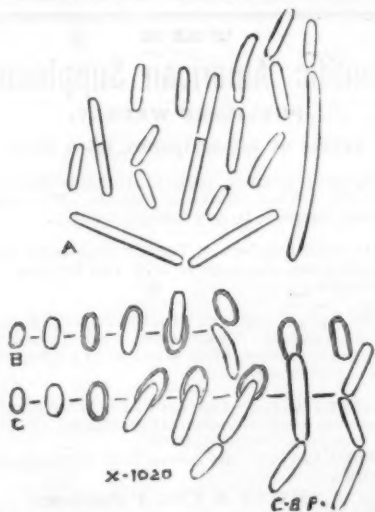
FIG. 2.—BACILLUS AMYLOBACTER.

A, various forms of the Bacillus; B, germination of the spores produced in three-quarters of an hour; C, other spores after one hour and three-quarters.

Jensen informs me that in 1815 a well known and reliable agricultural writer, Mr. J. C. Drewson,* says that "the potatoes ought to be preserved above ground, for he had more than once seen potatoes stored in holes in the ground completely rotten, probably on account of water having found its way into the pits." Mr. B. F. B. Ronne, in the same periodical, in the same year, says that "in 1813 the potatoes in the pits had rotted to a great extent, not only with him, but with some of his neighbors. He thinks this due to water having percolated into the pits from the snow that year having been unusually deep." In the following year, 1814, 240 bushels of potatoes rotted in one pit, which constituted the half of its total contents.

This affection of potatoes was described by Schacht,†

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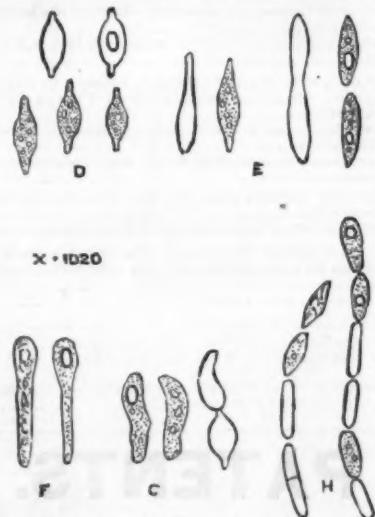
FIG. 3.—BACILLUS AMYLOBACTER.

D, spindle-shaped; E, elongated and ellipsoidal forms; F, capitate forms; G, vibrio-like forms; H, two linear series with separate swollen joints. (Figs. 2 and 3 after Prazmowski.)

as well as by other writers. It is one of the most important affections to which potatoes are subject. It attacks and destroys them while they are still in the ground in wet seasons, as well as after they have been

* *Landoeconomiske Tidsender,* 1815.
† Schacht, *Bericht über Kartoffelpflanze und deren Krankheiten,* 1856.

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lifted and stored in pits. The whole interior of a tuber affected with wet rot is rapidly converted into a foetid watery pabulum. The odor is quite characteristic; it is offensive and sourish. On the exterior appear various fungi, but these are the effect of the diseased condition into which it has passed, not the cause of it. Notably among these fungi are Fusisporium solani, a well known fungus, which Reinke and Berthold* have shown is not an autonomous species, but the conidia of one of the Sphæriacei, called by them Hypomyces solani, but which belongs rather to the genus Lisea of Saccardo. Another very common fungus is the Spicaria solani of Harting (Fig. 5, D), figured and described by him as well as by De Bary,† Schacht, and others, which Zopf‡ has shown to be the conidia of a Nectria, N. solani, Zopf (Fig. 5, A, B, C). Zopf also found a Chætomium, to which he gave the name C. bostrychodes.§ C. crispatum, Fckl.,∥ also occurs here, as well as many other species.

Wet rot is caused by one of the schizomycetes, namely, Bacillus amylobacter, Van Tieghem (Figs. 2, 3).¶ This is the Clostridium butyricum, Praz.,** and is considered to be the ferment of butyric fermentation, the *vibrion butyrique* of Pasteur. Reinke and Berthold †† describe and figure two bacteria, which they consider to be the cause of wet rot, namely, the Bacillus subtilis of Cohn and Bacterium navicula, but Prazmowski has shown that these are not two species, but only conditions of the same, which is not B. subtilis at all, but B. amylobacter. Bacillus amylobacter in the presence of water first attacks the parenchymatous cell walls, and by destroying them permits the starch cells to escape. These in their turn are attacked and disintegrated by the action of the bacillus, the result of which is, that the solid tuber becomes converted into a diffluent mass. The starch grains float about in this creamy, offensive pabulum, resisting, as they do, longest the influence of the bacillus, but eventually they become disorganized (Fig. 4). The development of Bacillus amylobacter, as observed by Prazmowski, is given in Fig. 3.

During the past winter (1883–84) I had ample opportunities for becoming acquainted with wet rot while experimenting with phytophthora. If conidia of this fungus be placed upon potato slices, in the course of a few days, depending upon the temperature at which the culture is made, the slices become diseased; but it very often happens that, as well as being affected with the phytophthora, they are attacked by wet rot. It is often a race between the phytophthora and the wet rot. If the former has had time to establish itself, a crop of conidia is obtained; but if the wet rot gains the upper hand, no conidia are developed. After several failures from this cause, Mr. Jensen informed me how I could obtain a pure culture of phytophthora. To infect fresh slices of potato, the best plan is to shake up the conidia-bearing slices in a small quantity of water, and to dip the slices you wish to infect into this spore-charged water. It is obvious that when once wet rot gains admission into your material, which it is sure sooner or later to do, you will fail in obtaining conidia. In this case a pure culture may be obtained by availing yourself of the fact that phytophthora conidia can withstand a greater amount of desiccation without being killed than the organism or organisms causing wet rot can. It is only a question of degree, for when once the conidia are thoroughly dried, they are killed. Having, then, dipped the fresh slices into washings of the old ones which contain both conidia and bacilli, instead of at once placing them under a bell glass, allow them to be exposed to the air until they are just dry on the surface, so that no fluid can be seen upon them. Of course the length of time necessary for this depends upon the temperature of the room in which the experiment is made; generally they will require to be turned over, so that both sides may be equally dried. They may be then placed under a bell-glass; the conidia will be alive, but the bacilli dead, or, at any rate, in a state of quiescence, and a pure culture of phytophthora will be obtained. If the precaution of drying be not taken, the slices in a few days will become soft and pasty, and eventually diffluent, like cream, and horribly foetid. Hence it is obvious that there is nowhere for the mycelium of the fungus to grow, for it cannot develop among a mass of starch granules, and so it is that the wet rot is fatal to the phytophthora. But this is not all; the presence of the mycelium of phytophthora in a tuber predisposes it to wet rot. We know, as a matter of experience, that diseased tubers rapidly become soft and pass into a loathsome mass of sour-smelling, offensive pulp. The mere presence of phytophthora mycelium does not cause this, but it results from the advent of wet rot.

Wet rot is highly infective; one tuber will affect contiguous ones, provided always that there is a sufficiency of moisture, especially if this be stagnant, as when they are in the damp ground. Wet rot takes place largely in potato graves, and annually destroys immense numbers of tubers.

DRY ROT (TROCKENFAULE, OR STOCKFAULE).

This condition is described and figured by Schacht.‡‡ According to Kuhn,§§ it first appeared in Germany in 1830, when it caused much apprehension on the part of the potato growers. Kuhn met with it in 1841–42 in Saxony, where it occurred with such virulence that the attention of the Government was drawn to it, and measures were taken to obtain accurate information concerning it. Since 1842 it has been more or less common in Germany. It always makes its first appearance at the time the potatoes are lifted. Externally the affected tubers appear at first to be quite normal, but traces of the disease are to be found in their interior upon cutting them open. They soon, however, present a dead-looking appearance externally, and upon section

* Reinke and Berthold, in *Zersetzung der Kartoffel durch Pilze,* 1879, pp. 27, 28, t. i. and ii.
† De Bary, *Die gegenwärtig herrschende Kartoffelkrankheit.,* 1861, t. i., f. 13.
‡ Zopf, *Ueber Chætomium,* *Sitzungsb. der Bot. Vereins der Provinz Brandenburg,* 1878.
§ Zopf, *Entwickel. der Chætom.,* p. 81, t. iv., f. 14-28.
∥ Fuckel, *Symbol. Mycol.,* p. 90.
¶ Van Tieghem, *Bull. Soc. Bot. France,* vol. xxiv., 1877.
** Prazmowski, *Entwicklungsgeschichte einegen Bacterien Arten,* 1880, pp. 34-37, t. ii., f. 1-4.
†† Reinke and Berthold, *loc. cit.,* pp. 15-25, t. vii., f. 7-14.
‡‡ Schacht, *Bericht über Kartoffelpflanze und deren Krankheiten,* Berlin, 1856, pp. 19, 20, t. viii.
§§ Kuhn, *loc. cit.,* pp. 202-206.

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show in their centers brownish or bluish musty stains. They become hollowed, the cavity or cavities are surrounded by a brownish or blackish corky formation, which gives to the interior of the tuber a leathery consistence. By degrees the whole interior of the tubers becomes attacked with the dry rot; the surface then gets shriveled, and various moulds appear upon it, which impart to the interior a variously colored, mottled look. The affected tubers have a disagreeable sweetish mouldy odor, and when the dry rot has advanced to this stage, they are friable. The disease, Kuhn says, "always spreads from the interior outward, and may thus always be distinguished from the disease caused by phytophthora, which spreads from without inward." So that a tuber affected with dry rot may be quite decayed and mouldy inside, while the exterior shows no signs of disease. This affection must not be confounded with the phytophthora diseased tubers which have been kept in a dry place, for although these may be "rotten and dry, yet they are not affected with dry rot." Reinke and Berthold * describe the dry rotted tubers as being internally spongy, and dry to the touch like tinder, having a marbled or spotted appearance. They are lighter than sound tubers. In the most advanced state the proper substance of the tuber is replaced by a yellowish-white, friable, pulverulent, or a floccose, tinder-like substance. On section the affected tuber has a whitish, yellowish, reddish, or brownish marbled appearance. It does not appear that dry rot, as a distinct disease of the potato, has been recorded hitherto in England, but the descriptions given above seem to recall to my mind certain diseased tubers which
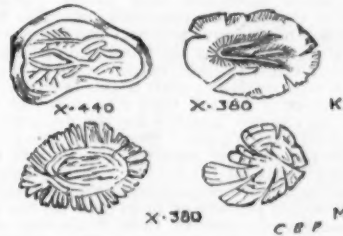

FIG. 4.—STARCH GRAINS ATTACKED BY BACILLI.

J, K, L, M, starch grains in various degrees of disintegration. Magnified. (After Reinke and Berthold.)

I have from time to time seen. I find upon conversation with horticulturists that they, too, have noticed it, and, although never having their attention specially directed to it, have regarded it as a form of the potato disease (phytophthora).

Since the above was written, I have had the opportunity of personally examining a true specimen of dry rot. The affected tuber was externally perfectly normal, showing no indication whatever of disease. It was cut in halves, however, for another purpose, and is represented at Fig. 135, C, p. 788, vol. xxii. This figure, however, scarcely gives a correct idea of its appearance. The central part was rather darker than the sound part of the flesh, but not so much as the figure shows. It was surrounded by an inky-black marginal zone, the outer border of which was sharply defined, but toward the interior this became shaded off. One-

FIG. 5.—NECTRIA SOLANI. (AFTER BERTHOLD.)

A, slightly enlarged; B, asci with sporidia, magnified 600 diameters; C, sporidia, isolated; D, spicaria solani, magnified 400 diameters (after De Bary).

half of this tuber was exhibited to the Scientific Committee, the other half I sent to Prof. Kuhn, who informed me that it was a typical specimen of dry rot in its early state.—*The Gardeners' Chronicle.*

* *Die Zersetzung der Kartoffel durch Pilze,* pp. 10-13.

[SCIENCE.]

THE TILE-FISH.

In the spring of 1879 a Gloucester fishing-schooner, accidentally fishing on the Gulf-Stream slope south of New England, found in abundance a fish which later proved to be new, and was described under the name of Lopholatilus chamaeleonticeps, but which the fishermen named tile-fish. The fish-commission later found that it possessed excellent edible qualities; and the prospect of thus adding a new fish to our east-coast food-fishes created a stir at the time. So bright were the prospects, that a fishing-vessel was even being fitted out, for the purpose of catching this new fish, when, in the early spring of 1882, reports were brought in by vessels that dead tile-fishes were seen floating in immense numbers over areas of many square miles. These dead or nearly dead fishes were floating, belly upward, all the way from off Cape Hatteras to Nantucket, and in such numbers that there were in one case estimated to be fifty in a square rod. As they weighed from five to fifty pounds, even allowing for exaggeration, the sight must have been strange. They were examined, and found to be perfectly healthy, and some were eaten. All were not dead, but some seemed to be benumbed; and, when placed in the sun on deck, they revived sufficiently to move the muscles slightly. There were some other fishes among them in a similar condition; but, as none were saved, the species cannot be identified. This great abundance of paralyzed fishes on the surface, without any apparent reason, attracted much attention, and many causes were ascribed to explain the phenomenon. The fish-commission itself made inquiries; and the following startling statistics concerning the number of dead fishes are taken from Capt. Collins' official report. They covered 4,250 square miles; and, if one-twentieth of the number recorded by the man who saw the most be taken as an average number for the area, we have a total of 1,438,720,000 fishes. Even if we allow only one fish where the observer reported 400, we still have an astounding total of 71,936,000 fishes. Taking ten pounds to be the average weight, we find that there were 719,360,000 pounds of dead fish on the surface. The extreme abundance of these fishes was never imagined before their destruction. This destruction is not without parallel; for in certain bays on the coast of Labrador, when icebergs have grounded, cod have been killed in great numbers by the sudden decrease of temperature, and their bodies washed ashore. In Texas, during the Mexican war, after a very cold night, enough fishes were washed on the beaches in a be-

THE TILE FISH.*

numbed condition to furnish food for Gen. Taylor's whole army. Other cases are recorded where volcanic action has caused similar destruction. Of the theories suggested to explain the destruction, all were discarded but that of cold water. Volcanic action could not be used to explain it, because there was no disturbance; and disease would not account for the phenomenon, because all the fishes were perfectly healthy.

The tile-fish is a warm-water fish, and belongs to a family which is peculiarly a tropical group. The part of the ocean which these fishes inhabit is a portion of the rapidly sloping Gulf-Stream slope. A narrow belt in this region, having a depth of from seventy to a hundred and fifty fathoms, is so influenced by the Gulf Stream as to have a nearly uniform temperature of about 50° F. the year round. On either side of this belt is one of much colder water. The inner shallow shore-water often descends in winter below 32° F., and beyond to the great ocean-depths the temperature gradually descends. This belt, being so much warmer and more uniform in temperature, is, as a natural consequence, inhabited by a different fauna; in fact, by a tropical deep-sea fauna, an extension of that of the West Indies. Not only the tile-fish, but certain crustaceans, are examples of these. Naturally they would be sensitive to cold. During the spring of 1882, violent and long-continued easterly and northerly winds prevailed, and numerous ice-bergs stranded on the George's Banks just north of the belt. We have every reason for believing that these winds carried the inshore waters, which were naturally cold, but whose temperature had been lowered by the stranded bergs, across the border-line and into the warm area. If this were the case, such delicate animals as the tile-fish could not possibly stand the sudden change which their more hardy neighbors could easily live through. So it was that the tile-fish and a few other species were exterminated from these grounds. Although the fish-commission has organized many extensive expeditions for the sole purpose of searching after the tile-fish, not a single specimen has since been found, either of the tile-fish or the other species. Whether or not they still exist in waters more southern is an open question; but we understand that Professor Verrill believes they will be found there. At any rate, it is certain that they are entirely absent from their former haunts, and that, if they do exist elsewhere, many years must elapse ere they inhabit this bank again in abundance. Such sudden changes as these, and local extinction of several

species by such simple means, cannot help throwing much light upon paleontological geology.

<div style="text-align:right">RALPH S. TARR.</div>

THE GENESIS OF THE HUMAN MIND.

Two lectures, bearing the title "Is the Human Mind of Animal Origin?" have been lately delivered at the London Institution by Mr. George John Romanes, M.A., LL.D., F.R.S., Secretary of the Linnæan Society. Assuming the truth of the general theory of evolution, both as regards bodily structure and mental organization, so far as the lower animals are concerned, the lecturer explained in his opening lecture last week that even among evolutionists there was still a difference of opinion on the question whether the mind of man admitted of being regarded as the product of a natural genesis—in other words, whether the human mind was of animal origin. Considering the question first on purely à priori grounds, Mr. Romanes observed that if it were admitted, in accordance with his original assumption, that the process of organic and of mental evolution has been continuous throughout the whole region of life and of mind, with the one exception of the mind of man, it becomes antecedently improbable that the process of evolution should have been interrupted at its terminal phase. And, indeed, looking to the very large extent of the analogy on which this consideration is founded, he thought that the presumption raised could only be fairly counterbalanced by some very cogent and unmistakable facts proving the virtual impossibility of animal intelligence passing into human. Next he pointed out that in the case of every human being there is presented to actual observation a process of gradual development, or evolution, extending from a zero level of mental life in infancy and culminating, perhaps, in genius. Moreover, so long as the human mind is passing through the lower phases of its development, it ascends through a scale of mental faculties which are pari passu identical with those that are presented permanently by the psychological species of the animal kingdom. Lastly, it is a matter of actual observation that in the history of the human race, as recorded in documents, traditions, antiquarian remains, and flint implements, the intelligence of the race has been subject to a steady process of gradual development. Thus, on the whole, a strong prima facie case is made out in favor of the view that the human mind, like everything else in organic nature, has been evolved. Leaving the à priori side of the question, Mr. Romanes next turned to the side of direct evidence. Here the problem that stood for investigation was that of comparing the faculties of brute with those of human intelligence, in order to ascertain the points wherein they agree or differ; for thus only can the probability be finally determined as to whether the one order of intelligence is continuous or discontinuous with the other. If we had regard to the emotional faculties of brutes, we could not fail to be struck by the broad fact that the area of psychology which they cover is nearly coextensive with that which is covered by the emotional faculties of man. After showing that instincts are common to the brute and the man (although preponderating in the former), Mr. Romanes passed on to consider the faculty of reason. He maintained that although this faculty greatly preponderates in man, it is also true, in the words of Milton, that the lower animals "reason not contemptibly." The only explanation of there being any difference of opinion upon this point is, according to Mr. Romanes, because different writers use the term "reason" in different senses, it being often understood to include self-consciousness and introspective thought. But if the term were restricted to its only proper meaning, there could be no question as to the rationality of brutes. This meaning is that of ratiocination, or the drawing of inferences from the perceived equality of relations, i. e., of inferring results from past experience. The lecture was profusely illustrated with examples of emotional and rational actions on the part of animals.

The second lecture, which was delivered yesterday evening, was devoted to a consideration of all the points of difference between animal and human intelligence which had ever been alleged. Of these, the only valid one was held to be the high power of abstraction which was characteristic of the human mind, and which constituted the basis of all the other differences. The question, therefore, for evolutionists was to explain the growth of abstraction; and, as all psychologists were agreed that abstraction depended upon language, the whole question became resolved into this—Why had man alone of animals been gifted with the Logos? Now, in its essence the Logos consisted in the power of predication, or of expressing a judgment; "if the brute could think 'is,' man and brute would be brothers." Was it, then, conceivable that the power of predication could have been developed by way of a natural genesis? To answer this question in the affirmative, Mr. Romanes argued that animals undoubtedly possessed in germ the faculty of making signs for the purpose of intentionally communicating feelings and ideas. The signs which they made were necessarily restricted to those of tone and gesture, except in

the case of the talking birds, where alone the anatomical conditions required for the uttering of articulate sounds were present. Evidence was then given to show that talking birds and children when first beginning to speak learned by special association correctly to name objects, qualities, actions, and desires. This first stage of spoken language Mr. Romanes distinguished as the denominative stage, and observed that it would certainly be exhibited by domesticated monkeys, seeing that they were both more intelligent and more imitative than birds, if any of them had happened to have been able to articulate. Now, if once the name of an object and the name of a conspicuous quality belonging to the object were used in apposition, the copula was latent in thought, and only required a further advance of abstraction itself to become an object of thought. The only requisite to this further advance was the growth of self-consciousness (which was shown to arise in children from the naming of self as an object), and thus the denominative stage of language passed into the predicative stage. Mr. Romanes concluded by arguing that, given a species of anthropoid ape with the power of uttering articulate sounds, and there would be no more reason for wondering that this passage from the denominative to the predicative stage of language should have taken place in the brute, than there was for wondering that it took place in the child.